THE

AGRICULTURAL LEDGER.

1895—No. 4

COAL.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol II, C. 1414—1441*]

REPORT ON INDIAN COALS:

Result of examination in the Research Department of the Imperial Institute, London.

Other papers that may be consulted:

Indian Coal Hand-Books of Commercial Products, Indian Section (No 9) Imperial Institute Series.

CALCUTTA
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

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(3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein,

(4) To secure a connection between all papers of interest published on subject relating to economic products and the official Dictionary of Economic Products With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it

E C. BUCK,
Secretary to the Government of India

(Mineral Product Series, No. 4.)

THE AGRICULTURAL LEDGER.

1895—No. 2.

COAL.

[*Dictionary of Economic Products, Vol II*, C. 1414—1441.]

REPORT ON INDIAN COALS

Result of Examination in the Research Department of the Imperial Institute, London

Previous Analyses

The following report (furnished by SIR FREDERIC ABEL, Secretary and Director, Imperial Institute, London) gives the results of the technical examination, and, in some cases, those furnished by ultimate analyses, of the series of thirty different Indian coals sent by the Department of

... ines and collieries in

... sible to correspond with the Hand-book on Indian Coals, No. 9, Imperial Institute series

...

in many cases there is a striking difference between them and those furnished by the samples under report By communication with Mr Ball it has been ascertained that while the results given in his work are the best that could be obtained at the time, some of them being, in his opinion, perfectly trustworthy, they are not all to be relied upon alike as accurate

Sampling.

Sampling —Pieces of several pounds weight were sawn from the large ... e completely broken up ... hat it would have been ... a hundredweight at com- ... for analysis, the speci- mens appeared, in the majority of cases, to be fair samples of the seams they represented

Technical Analysis

...

flame for two minutes longer, being kept at a bright red heat. After cooling in a desiccator, it was weighed and the loss reckoned as volatile matter,

Technical Analysis

which of course included moisture. The well-fitting lid of the crucible was not removed during the whole of this process In the case of caking coals a very small [illegible]

[illegible]

... and heated until nothing but ash remained, when it was cooled in the desiccator and weighed. The loss was reckoned as fixed carbon and the residue as ash; the colour of the ash will be found recorded in the tables.

For the estimation of the sulphur about 1·5 grms. of coal were fused in a platinum dish [illegible] chloride [illegible] part. [illegible] grated [illegible] cake, [illegible] acidified [illegible] ite hot, precipitated with barium [illegible] its contents warm, on the water bath, for three or four hours, the precipitate of barium sulphate was [illegible]

[illegible] method was at least equal to the one ordinarily in use, viz., that of igniting the precipitate of barium sulphate in a crucible, and is, for speed, much to be preferred. These estimations were made in duplicate, a difference of 0·3 per cent. being considered quite allowable, after considerable experience. In some cases the sulphur left in the coke was estimated.

Ultimate Analysis.

Ultimate Analysis.—This was conducted in the usual manner; the coals were first dried in a current of hydrogen gas at 120° C. for half-an-hour. This was done by pushing the platinum boat containing the weighed quantity of coal into the middle part of a long piece of wide [illegible] through the walls of a saucepan. [illegible] allowed to diffuse through a small [illegible] otton wool, inserted in a cork at the other end. A burner was lighted under the saucepan, and a thermometer fixed into a hole in the lid; a very convenient air-bath was thus obtained The coal, after being dried, was then burned in the [illegible] The tube was filled to [illegible] 4½ inches [illegible] by plugs of [illegible] inches. It [illegible] combustion [illegible] timated by the technical method. This is doubtless due to the presence of iron and other minerals in the ash, which are left in a higher state of oxidation after being heated in oxygen.

The following is a tabular statement of the results arrived at, together with descriptions of the character of each particular coal.—

Results of Technical Examination.

COAL

Technical Analysis

Report on Indian Coals

Results of

Province	Mine	Indian Invoice Number	Imperial Institute Number	Fixed Carbon %	Volatile matter %	Sulphur %
Assam	Makum	1828	3032	53 28	45 45	1 02
"	Cherra Punji	96	1445	49 54	45 72	3 98
"	Maoflong	97	1446	49 79	47 25	3 08
Baluchistan	Khost	93	1441	49 58	45 27	4 82
"	"	94	1442	41 50	48 94	0 74
Bengal	Kummardubhi	99	1448	51 48	44 67	0 53
"	Raneegunge	1661	2865	42·05	45 60	1 58
"	Barakar	652	1996	53 49	28 18	0 62
"	Karharbaree Jogiland	636	1980	56 45	32 78	0 51
"	Do Lower Seam	639	1983	64 80	27 83	0 42
"	Do. Upper Seam	641	1985	66 80	27 85	0 40
"	Sodepore	1658	2862	49 95	41 57	0 29
"	Lakdee	1659	2863	57 70	33·68	0 53
"	Nimcha	1660	2864	42 50	42 86	0 32
"	Kooldeah	1662	2866	61 20	26 72	1 50
"	Searsole	1663	2867	49 41	39 30	1 63
"	Madhubpur	1664	2868	38 80	44 08	1 54
"	Sanctoria	1668	2872	49 32	39 94	1 53
"	Derhagar	1665	2869	42 71	45 26	1 51
Burma	Burma Coal Co	3531	6157	33 57	57 93	0 33
"	" "	3532	6158	3 58	28 05	0 11
Central India	Umaria	256	1605	59 65	16 72	0 32
" "	"	322	1671	55 97	17 43	0 43
Central Provinces	Mohpani	1648	2852	42 46	33 24	0 50
" "	Warora	316	1665	41 40	45 10	0 94
" "	"	318	1667	40 97	46 25	1 21
" "	Gadawarra	1649	2853	42·61	37 26	0 39
" "	"	1650	2854	41·00	39 35	0 44
" "	"	1651	2855	45 35	45 42	0 43
Hyderabad	Hyderabad	87	1436	43 55	43 74	0 29

C. 1414—1441.

examined at the Imperial Institute, London | COAL

Technical Examination. | Technical Analysis

Ash. %	Colour of Ash	Caking properties.	Other characteristics of the sample.
1·07	Pale chocolate .	Does not cake .	A glistening black coal, clean to handle, easily broken, conchoidal fracture
4·74	Dark red . . .	Cakes . .	A dull black coal, dirty, very hard, with cuboidal fracture
2·96	Yellowish brown .	" . .	Bright and clean, with fossil resin in many places
5 15	Terra cotta . .	" . .	Clean bright and hard, but disintegrating with a white efflorescence, and with evolution of sulphuretted hydrogen
9 56	Yellowish brown .	" . .	Clean, bright and hard, with obtuse fractures
13·85	Grey	" . .	Layers of dull and bright coal, clean rounded fractures
12 35	Fawn colour . .	" . .	Bright, hard and dirty
18 33	Greyish white .	" . .	Dull black, dirty, very hard
10 77	White	" . .	Laminated, very clean, cleaves in small cubes
7 37	Dark yellow . .	Does not cake .	Dull black, clean, not very hard
5·35	Yellowish brown	" " .	Dull black, hard, clean, breaks into cubes.
8 48	Light yellow . .	Cakes . .	Bright, dirty, fairly hard
8 62	White	" . .	Mixed dull black and glossy, the latter crumbles readily, clean
14 64	Brownish yellow	" . .	Dull and glossy laminæ, clean and hard
12 08	White	" . .	A dull black coal, clean and hard
11 29	Lemon yellow .	" . .	A glossy coal, hard, but with soft patches
17 12	Brownish yellow	" . .	A dull coal, laminated, hard with soft patches, clean
10·74	Yellowish grey .	" . .	A dull coal but with bright patches, hard and clean.
12 03	Fawn colour . .	" . .	A clean bright coal, cleaving in layers.
8 50	White	Does not cake .	Dull black, clean and hard, with rounded surfaces and fractures
63 39	"	" " .	Dull black with glossy patches, very soft and soapy to touch, clean.
23·63	"	" " .	A clean dull coal with irregular cleavings, easily broken
26 60	Greyish white .	" " .	Dull, soft, clean and contains fossil resin
24 30	Brownish yellow	" " .	Dull, laminated, very hard, fairly clean
13·50	White	" " .	Dull with bright patches, clean and rather soft.
12 78	"	" " .	A clean silky coal, easily broken, cleaving in cubes
20·13	"	Cakes . . .	Dirty, alternate layers of dull and very hard coal, and bright coal easily broken
19 65	Yellowish brown	" . . .	
9 23	Light yellow . .	" . . .	Dull, hard and clean, with occasional glossy layers.
12·71	Yellowish brown	Does not cake .	Irregular fracture, extremely hard, dull, clean coal, with thin streaks of glossy coal

COAL.	Report on Indian Coals.

Results of Analysis.

mean of several analyses), and of a specimen of coal from New South Wales, is also given in tabular form for purposes of comparison :—

Indian coal.

Results of Analysis.

District or Province	Mine	Indian Invoice Number	Carbon	Hydrogen.	Ash	Moisture	Sulphur.	Nitrogen, Oxygen, etc.
Assam	Makum . .	1815	77·31	5·43	1·27	5·07	1·02	11·90
"	Cherra Punji .	96	77·75	5·83	4·74	1·43	3·98	6·25
"	Maotlong .	97	75·03	5·17	3·23	3·15	3·08	10·32
Baluchistan	Khost . {	93	78·33	4·91	5·57	3·83	4·83	9·41
		94	70·38	5·55	10·64	3·46	0·74	10·03
Bengal	Kumardahl .	99	70·43	4·70	13·85	1·80	0·53	8·63
" Karharbaree .	Lower Seam .	630	80·75	4·32	7·37	1·33	0·42	5·91
	Upper Seam .	641	83·53	4·59	5·35	1·38	0·40	4·85
"	Sodepore .	1658	72·09	4·87	9·03	3·34	0·29	10·18
"	Llakdee . .	1659	75·33	4·60	9·29	2·23	0·53	8·02
Burma	Burma Coal Company .	3531	60·23	4·64	9·29	11·55	0·33	13·95
Central Provinces . . .	Gadawarra .	1631	67·63	4·37	9·73	7·07	0·43	10·75

British and Australian coal

Composition of British and Australian Coal.

(For purposes of comparison)

Coal	Carbon	Hydrogen	Oxygen and Nitrogen	Sulphur	Ash	Water
Northumberland Caking (mean of 4 samples) . . .	80·29	5·32	11·79	0·91	1·68	Exclusive of water.
Welsh Caking (mean of 3 samples) . .	83·00	5·75	7·84	0·77	2·64	
Welsh Non-caking (mean of 4 samples) .	86·92	4·39	4·30	1·28	3·42	
South Staffordshire Caking (mean of 4 samples) . . .	75·41	4·62	16·29	0·71	2·97	
Scotch : Non-caking (mean of 3 samples) .	79·21	5·23	13·28	0·90	1·38	
New South Wales .	77·65	4·94	10·63	0·58	3·28	2·95

C. 1414—1441.

G. I. C. P. O.—No. 18 R. & A. D.—1-7-95.—, .—A. E des.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those of more direct agricultural or industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

This sheet and the title page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page

THE

AGRICULTURAL LEDGER.

1895—No. 3.

CROPS.

DICTIONARY OF ECONOMIC PRODUCTS, Vol. II., C. 2089.

CROPS AND CLIMATIC CONDITIONS:

A Note on some General Observations on the relation of Indian Crops to Climatic Conditions—by THE EDITOR

CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
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E C BUCK,

Secretary to the Government of India.

(Agricultural Series, No. 10.)

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CROPS AND CLIMATIC CONDITIONS

A Note on some General Observations on the relation of Indian Crops to Climatic Conditions—by THE EDITOR

Meagre character of present information

It has often been felt in the Office of Reporter on Economic Products that we very much require to establish a system of recording observations on the relation of crops to climatic conditions The information at present available is of the most meagre character For example, I have spent some days in reading through the articles given in the *Dictionary*, on the more important crops, in order to see if I could furnish from these a table of the dates of sowing and reaping I have failed Fearing this might have been an omission, I have reconsulted the Gazetteers and other provincial publications, from which the Dictionary was compiled, but again I have been unsuccessful In the case of one or two crops I can find these dates for more than half the provinces, but in the majority of cases I can only speak with any degree of certainty regarding one or at most two provinces Such general terms as "sown at the beginning of the rains" are frequent, without its being stated what month that corresponds with and in a like manner the remarks—a *Rabi* (Spring) or a *Kharif* (Autumn) crop, appear to be intended by the local authors as fully meeting all possible requirements of this nature The uselessness of such terms can at once be shown by reference to any one province, thus for example, in the Panjab—Wheat, Gram, *Tur*, Peas Mustard Linseed, are Spring crops, but the range of the sowings and reapings of these are —sown from June to December and reaped from February to April It is obvious, therefore, that the term 'Spring' (*Rabi*) by itself cannot be accepted as of any value

Rainfall more potent than temperature.

Speaking generally, it may be said that rainfall has in this country, a more potent influence than temperature Extremes of heat and cold may be the controlling factors very possibly in the natural distribution of most wild perennial plants, but with annual crops rainfall or a supply of water artificially is a *sine quâ non*

Hence it follows that the expansion of the area of cultivation and the increase of production in cultivated tracts is more dependent on measures of irrigation than anything else The range of temperature, from summer to winter, and the distribution of land into vast plains, extensive tablelands and lofty highlands, allows of a diversity of cultivation possessed by few other countries in the world To suit this wide climatic range the cultivator fortunately possesses an extensive series of crops And further, though ignorant of the principle involved, he has produced by selection special races of certain crops that are direct adaptations to existing conditions Hence we have in India both Spring and Autumn forms of rice, wheat, *jowar*, castor-oil, *tur*, sugar-cane and cotton The one series of races may be grown on geographically temperate areas, or on tracts which during the Winter months are temperate, while the other may be raised over tropical tracts or during the Summer months Botanically, these races are often quite indistinguishable, though their recognition is to the cultivator a matter of supreme importance. As a result of these considerations we have the startling state of affairs that a journey from one extreme of India to the other may reveal the cultivators engaged in every stage of the operations connected with certain crops, such as preparing the soil, sowing, watering the advanced crop, reaping, thrashing, and carrying the produce to the market For example, were the journey made in June from the Panjab to South India, the cultivators would in the north be found engaged in the early preparation of the land, for the crop to be sown in September to December, in mid journey they would be seen tending the mature *kaple* wheat of the Konkan, and in Mysore and some parts of Madras Presidency they would be found sowing wheat— a crop that will be harvested in September, and thus practically at the time that the great wheat crop of Northern India is being only sown Numerous such examples might be given of the varying climatic conditions that prevail at any one time in this vast Continent and of the direct adaptation of crops within restricted portions of it, to seasonal changes It may, perhaps, suffice, however, to mention one other example, namely, that of *jowar* (Sorghum vulgare) which in India is after rice the most important single article of food In Madras it is sown in January and very nearly right through the year to November, so that there are harvests of this grain every three or four months after sowing, the chief being

Diversity of crops

Diversity of conditions

January-February, April May, June-J
In Hyderabad it is sown in June and
November with the harvests four m
sowings are in June, July, August,
accordingly both Spring and Autumn harvests. But on turning from Southern and Western India (the regions that may be said to have the strongest oceanic climates) the plant becomes an Autumn crop, the sowings being in June, July and August, and the harvest in October to January. It is thus significant that the production of Spring crops of Sorghum—a plant which otherwise ripens in the Autumn—should correspond to the area of Autumn wheats, a cereal which in other parts of India ripens its crop in the Spring The explanation in both cases is doubtless the same, namely, the great uniformity of temperature, dampness of the air and more or less frequency of rain in

The arid and the humid zones

Autumn and Winter as compared with the more interior and northern tracts of India where there is but one season of rainfall The exact relation of meteorological observations to the conditions of the crops is, however, a subject upon which I find myself unable at present to express any very definite opinion It has often been pointed out that a line drawn from about Bombay round the southern extremity of the Central Provinces to Patna in Behar, would divide India into two sections which agriculturally are very different In the upper section the Winter months are cold and remarkably like the Summer months of Europe The lower is, on the other hand, perennially tropical, or at most warm temperate Moreover, the range of humidity within these two divisions is very dissimilar, in the north large tracts of country exist during Summer as arid, sandy deserts, while to the south the monsoon rains convert many thousands of square miles of country into inland seas The agricultural systems within the areas of these extremes (where agriculture is at all possible) must be essentially different from each other, and, speaking in general terms, it may be said that the intermediate zone is the chief source of pulses and millets The northern extremity is the wheat field of India and the south eastern the rice inundations Figuratively speaking, the country is as it were tilted on one side west and south from the belt of land that may be spoken of as connecting the arid and the humid extremes This connecting belt—which corresponds to a large slice of the Gangetic and Indus basins—has well marked Spring and Autumn crops or sub temperate winter-grown plants of one class and tropical plants raised in Summer and reaped in Autumn, that are botanically not tropical races of the Spring stock, but constitute an entirely distinct series The vast tableland and the rich uplands and plains to the south and west have, as already explained a complete blending of forms to suit the varying climatic conditions, but many of these are all more or less related to each other There is no sharp isolation botanically between the Spring and Autumn crops and the most noteworthy staple of this region is cotton In Bombay it may be said wheat decreases in merit from the Panjab frontier toward the sea coast in the inverse ratio to the improvement in cotton In South India cotton decreases in merit wheat practically disappears, and the swampy types of Bengal vegetation re appear more especially in the coast districts Maps of India if shaded by colours to show percentage of wheat and of rice cultivation to total cultivation, would manifest for wheat a deepening of colour on passing inland owing to the darkest shades having to be given in the Panjab—the most remote area from marine influence or from rain inundation With rice, on the other hand the shading would be in the reverse order deepest as a fringe around the coast and becoming fainter and fainter on passing up the Gangetic basin towards the wheat areas

Selection of crops to suit climate

The evolution on the one hand of tropical and temperate races of a plant to meet the seasonal changes of certain portions of India, and on the other hand, the selection of entirely distinct summer and winter crops for other tracts is one of the most striking peculiarities of Indian Agriculture The best known parallel case in European Agriculture is the existence of Spring and Winter wheats

CROPS.	On the relation of Indian Crops

But it would seem as if the explanation of this multiplicity of races lies in the peculiar influence of the humidity and rainfall (a condition scarcely experienced in Europe) far rather than in the changes of temperature which are characteristic of the regions in question The 'hot season of the tropical portions of India acts the part of the Winter of temperate regions Herbaceous plants wither and disappear, trees and shrubs shed their leaves and in most cases the spring like bursting of fresh foliage is the first precursor of the approach of the rains No better example of the all importance of the rains as the governing factor in Indian Agriculture could possibly be mentioned than that of rice, the swamp crop of the warm tropical regions There are not only two main crops that correspond as near as may be to the Spring and Autumn crops of Upper India, but several intermediate crops and even certain rices that from sowing to reaping occupy the soil for only sixty days while other forms require fully three times that period From the perplexing gradation of forms characteristic of the swamps the adaptation of rice to altered circumstances may be traced through the uplands of the Central Provinces, and the North West Provinces, and even to the light, sandy wheat fields of the Panjab until turning up the hills to temperate climes, we are confronted with rices that are grown on dry soils and require no direct inundation But it may fairly be said that diminution in rainfall and not decrease of temperature has been the restricting influence in the natural multiplication of the forms of rice It has been estimated that Bengal alone possesses as many as 10 000 recognizable forms of rice. While rice is grown in nearly every province of India, the number of forms or races of that crop met with in any one district, rapidly decreases on leaving the areas of inundation or of great humidity, so that in the dry cultivation of the wheat areas it is probable there are not half a dozen forms of rice But what is even more striking still may be here added, by way of concluding these remarks, *viz* that in dry areas no crop manifests a strong tendency to multiplication of forms The well recognizable crops of wheat that are grown in the Panjab might be embraced by, perhaps not more than a dozen vernacular names It is much the same with barley, mustard, linseed safflower, etc A striking change takes place with the pulse and millet areas and this culminates further to the south and east, in the bewildering multiplicity met with in the humid and often inundated tracts of the tropics.

Rains all important.

Forms of rice

While one may thus mention many examples of the striking effects of climate on the nature and character of Indian Agriculture, it is by no means so easy to furnish direct statistical returns nor to frame special tables that might be used in future to record such information To say that a crop is sown and reaped between certain periods would naturally be very misleading if applied arbitrarily The provinces of India even, when dealt with separately, are far too large for any such generalizations Thus, for example, in Madras there are two seasons of sowing and reaping that are directly governed by the monsoons Throughout most of the Presidency the rainy season is produced by the north east monsoon which breaks towards the end of September Seed is accordingly

Generalisation on climate and crops not possible

sown in October, and the crops harvested in February. But in some districts the crops are raised under the influence of the south west monsoon, the sowings being made in April and May, and the harvest in August and September. Madras may be said to lie between 8° and 20° north latitude, so that it is entirely within the tropical zone. Yet it has been referred to three great sections (*a*) the dry region, (*b*) the moist region, and (*c*) the very moist region. The first has a rainfall of under 30 inches, and embraces portions of Kistna district, the northern division of Nellore, a large section of Kurnool, nearly the whole of Cuddapah, all Bellary and Anantapur, parts of Salem and Trichinopolly, most of Coimbatore and the eastern portions of Madura and Tinnevelly. Over this area rain falls during both monsoons, but only as occasional showers. As showing the approximation of this portion of Madras to that of the dry tracts of India that have a temperate winter, it may be said that it is within these districts that wheat is grown in the Madras Presidency. The moist region of Madras has a rainfall of over 30 inches, but the summer monsoons are very light and the major portion of the rain falls in October and November. This division embraces the whole eastern coast from Ganjam in the north to Madura. It also includes the whole of the Northern Circars, portions of Kistna, C[illegible] Chengalput, North [illegible] and the eastern slop[illegible] And lastly the very moist tracts of Madras may be said to be the whole of the West Coast from South Kanara to near Cape Comorin as well as the western slopes of the Ghâts. Below the Ghâts the rainfall varies from 110 to 130 inches and on the Ghâts 150 to 200 inches.

Rainfall more important than temperature

It would thus be obviously misleading to give an average of the sowing times of any one crop for the whole of the Madras Presidency. There is very possibly as great a range of variation within the three regions indicated as between Madras and Bombay or even the Panjab. To arrive at a satisfactory knowledge of the subject each province should be referred to as many sections as there are well marked areas [illegible]

as I have indicated in the case of Madras it might be possible to collect the further information required. But in the absence of a classification of the areas of humidity, and in our present state of ignorance regarding the dates of sowing and reaping of crops, the utmost that can be done here is [illegible] procurable from Gazetteers and ot[illegible] culars may be thrown into the fol[illegible] may be found useful, though its absolute accuracy is not vouched for :—

CROPS.	On the relation of Indian Crops

Statement showing the approximate Seasons of Sowing and Reaping

	Crop.	Panjab. Sown.	Panjab. Harvested.	Bombay. Sown.	Bombay. Harvested.
Cereals.	1. Wheat	0—12	4—5R	1—2 9—11	6—7K 2—4R
	2. Barley	10—12	3—4R	10—11	2—3R
	3. Indian Corn (Zea Mays) .	6—9	9—11K	6	8—9K
	4. Jowar (Sorghum vulgare). } Millets	7—8	9—12K	6 8—10	10—11K 2—3R
	5. Bajra (Pennisetum typhoideum) } Millets	7—8	9—11K	6—7	9—10K
	6. Rice	7—8	11K	6	10—11K
Pulses.	7. Gram or Chick pea (Cicer arietinum)	8—10	3—4R	9—10	2—3R
	8. Dal or Thur (Cajanus indicus)	6	3R	6—7	9—2R
	9. Mung or green gram	8	11—12K	5—6	8—9K
	.	8	11—12K	6	9K
	. folius)	7—8	11K	6—7	10—11K
	12. Shim or Poput (Dolichos Lablab)	7—8	11K	6—7	10—11K
	13. Kulthi or Horse gram (Dolichos biflorus)	7—8	11K	6—9	10—11K
	14. Peas	9—10	4R	10—11	2—3R
Oil-seeds.	15. Mustard	8—9	2—3R	*Nil*	*Nil*
	16. Rape	8—11	3—4R	10—11	2—3R
	17. Linseed	9—10	3—4R	11	2R
	18. Til (Sesamum indicum) .	7—8	11K	6—7	9—11K
	19. Castor (Ricinus communis)	6—11	K11—2R	6—10	K11—2R
	20. Ground-nut (Arachis hypogæa)	*Nil*	*Nil*	6	12
Fibres.	21. Cotton	4—5	K9—1R	6—7	K11—12—3R
	22. Jute		Not much cultivated	; has been tried	
	23. Sunn-hemp (Crotalaria juncea)	7	10—11K	7	10
Dyes.	24. Indigo	4—5	8—9	Being opened up.	
	25. Safflower (Carthamus tinctorius)	Little grown.		10—11	2—3R
	26. Sugar-cane	2 3	10K 12—2R	1—3 6	12—2K 5R

Note.—The letters R and K denote *Rabi* (Spring) and *Kharif*

C. 2089

to Climatic Conditions (G Watt) CROPS

the Principal Crops in the six chief Provinces of India

Central Provinces		North West Provinces and Oudh		Bengal		Madras		
Sown	Harvested	Sown	Harvested	Sown	Harvested	Sown	Harvested	
10—11	3—4R	5—10	3—5R	10—11	3—4R	5—6	9—10	1 Wheat
10—11	2—3R	9—10	3—4R	10—11	3—4R			2 Barley
6—7	10K	6—7	8—9K	7	9K	3—4 5—7 10—11 1—2	6—7K 8—9—10K 1—2R 5—6K	3 Indian Corn
6—7	11—12K	6—7	11—12K	6	9—10K	3 10—11 5—6—7	6—7K 1—2R 8—9—10K	4 Jowar
8	10K	7—8	10—11K	Little	grown	6 4 9 11	9K 6—7K 12 2R	5 Bajra
6	10—11K	2—3 6	8—9 12K	5—6 6—10 12—2 1—2	7—8K 10—1R 5—6K 9—10K	5—6—7 7—9 11—12	9—10K 11—2R 2—3—4R	6 Rice
10—11	3R	9—10	3—5R	10—11	2—3R	*Nil*	*Nil*	7 Gram
6	2—3R	6—7	K10—4R	6 9	3—4R 11—12K			8 Dal
6—7	10K	6—7	10K	9—10	12—1R	9—10—11 5—6	1—2R 9—10K	9 Mung
6—7	10K	7—8	11—12K			8—9	12—1R	10 Urad
7—8	11K	7—8	11—12K	8	12—1R			11 Moth
7—8	11K	7—8	11—12K	8	11—1R	7—8 6—8	2—3R 10—12K	12 Shim
6—8	11K	7—8	11—12K	8	11—12K	8—11 8—10	3R 12—2R	13 Kulthi
9	3R	10	2—3R	10—11	2—3R			14 Peas
8	3R	9—10	12—1R	10 11—12	1—2R 3—4R		-	15 Mustard
8—9	3—4R	10—11	4—5R	10	3			16 Rape
9	3—4R	10	4—5R	10	3—4R			17 Linseed
7—8	10—11K	6—7	10—11K	2—3 6—7 8—9	6—7K 11—12K 3R	4—5 1—2 7	7—8—9K 5—6K 11—12K	18 Til
7	12—2R	6—7	2—3R	8—11 3—4 10	3—5R 1—2R 6K	7—8		19 Castor
Nil	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*			20 Ground-nut
6	10K	7 6	2R 10K	4—7 9—12 1—2	9—1K 2—7R 8—9h	7—8—9 10—11—1	3—6R 1—8	21 Cotton
in the Central Provinces				3—6	6—10K	*Nil*	*Nil*	22 Jute
7	10K	6	9	6—7	8—9			23 Sunn hemp
Nil	*Nil*	4—6	8—9K	2—3 10 4	6—7K 6—7—8K	1—2 7—8 11	6—7—8K 10—1—2 4R	24 Indigo
Little	grown	9	2—4R	10—12—1	2—3—5R			25 Safflower
1—2	12K	2 3—4	11K 12—3R	1—2—3 4—5—6	12—1—2 1—2—3R	1—3—6	12—2—4	26 Sugar cane

(Autumn) crops, the figures are the months of the year

Time for sowing and reaping

The value of even an approximate statement of the average dates of sowing and reaping the crops of an entire province is open to as many errors as would be any statement of mean temperature or rain fall. There is no province in India that does not possess extensive variations in climate, soil and nature of products Little more therefore can be done at present than to express personal opinions, until the areas of India are grouped upon some scientific principle, and the data thereafter furnished that would justify conclusions being drawn as to the influences of climatic conditions on the production and preservation of the meritorious properties of crops The efforts that have been put forth in this country at acclimatization of foreign plants may (in the absence of the knowledge here indicated) be fairly correctly characterised as haphazard experiments and speculations Various attempts have been made by botanists to establish the assemblages of wild plants that are characteristic of certain Indian areas, but in dealing with the cultivated plants it would seem to me safer to work back from existing climatic phenomena than to reverse the order of things by seeking for climatologic explanations of the present crops The chief points that we require to know are —

Information wanted

(a) period of maximum rainfall in tracts of country isolated from the surrounding districts through that peculiarity,

(b) [illegible] ociation with maximum

(c) th [illegible] imum rainfall and humi- [illegible] and minimum temperature Average temperatures and average humidities are practically of no value in regulating the distribution of plants But the duration of a medium humidity or medium temperature is of vital importance. An abnormally high rainfall confined to a restricted period might have a destructive effect on the possible existence of certain wild vegetable forms while the same amount of rain diffused over a much longer period would allow of the growth of an altogether different series of crops, in fact make the difference between a garden triumph of laborious cultivation and a commercial production

GEORGE WATT.

12th March 1895

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series Those on Forestry, in the Forest Series Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

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This sheet and the title-page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page

THE

AGRICULTURAL LEDGER.

1895—No. 5.

DAIRY FARMING AND DAIRY PRODUCE.

(DICTIONARY OF ECONOMIC PRODUCTS, Vol. III., D. 15 a.)

MILK AND MILK PRODUCTS.

Note by Mr. JAMES MOLLISON, *Superintendent, Government Farms, Bombay.*

Other DICTIONARY articles that may be consulted:

Butter, *Vol. I*, B. 983.
Dahi, *Vol. III.*, D. 15.
Ghi, *Vol. III.*, G. 189.
Rennet, *Vol. VI., Pt. I*, R. 73.

Other PAPERS that may be consulted:

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The objects of THE AGRICULTURAL LEDGER are—

(1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers;

(2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept;

(3) To admit of the circulation in convenient form of information on any subject connected with agriculture or economic products to officials or other persons interested therein;

(4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify When the subject dealt with has not been taken up in the Dictionary the position it very possibly would occupy in future issues of that work will be assigned to it

E C BUCK,

Secretary to the Government of India.

THE

AGRICULTURAL LEDGER.

1895—No. 5.

DAIRY FARMING AND DAIRY PRODUCE

[*Dictionary of Economic Products, Vol. III* D 15 a.]

MILK AND MILK PRODUCTS

Note by MR. JAMES MOLLISON, *Superintendent, Government Farms, Bombay.*

Indian cows and buffaloes compared with European.

The milk of neat cattle varies considerably in composition. Certain breeds yield richer milk than others. Excepting Channel Island cattle, all milk breeds of Europe yield milk which is poorer in quality than the average of Indian cows. The average yield of selected Indian cows is much less than that of good specimens of any improved milch breed. Choice specimens of Jersey or Guernsey cows yield 30 lbs. or more per day of rich milk, whilst Holstein and Shorthorn cows have each a record of over 70 lbs. per day, though in quality the milk is poor. The yield of Indian cows rarely exceeds 20 to 25 lbs. per day. Twelve to 16 lbs. more nearly, however, approximate the average of good cows in full profit. Buffaloes on an average give considerably more than cows in India, and their milk is also much richer. Under skilful management there is no reason why the milk breeds of India should not be very much improved. It is quite within the bounds of possibility to breed up Indian buffaloes to become one of the best butter-producing breeds in the world. The best results respectively from a buffalo and a cow during the years 1891—93 on the Poona Government Farm are tabulated below:—

Milk yields of cows and buffaloes at Poona Government Farm.

	Number of Days in Milk.	Total Yield of Milk.	Number of Days Dry.	Value of Milk at current market rates.
		Lbs.		Rs.
Buffalo	459	6,669	1[illegible]	417
Cow	471	5,0[illegible]4	44	235

N. B.—[illegible]

DAIRY Farming.	Milk and

MILK

The comparative richness of milk may be gauged by the following analyses —

Average composition of milk.

	Average composition of Milk.		
	Indian Cow	Indian Buffalo	English Co
Water	86 13	82 05	87 20
Solids: Butter fat	4 80	7 98	3 70
Solids: Casein and albumen	3 03	4 00	4 00
Solids: Milk sugar	5 34	5 18	4 40
Solids: Ash	0 70	0 79	0 70

Quality of milk influenced by food

The food given to milch cattle influences the quality of the milk to a considerable extent Succulent food undoubtedly causes increased secretion, but at the same time it lowers the percentage of total solids The morning's milk is usually not so concentrated as the evening's milk, but on the other hand the morning yield is greater It is not clear why this increased yield should be associated with a diminution in the percentage of solids, unless we presume that the longer period which generally elapses between the evening and morning milking permits of fuller and freer secretion than the shorter interval between morning and evening The observations taken at the Poona Government Farm show about one per cent difference of total solids in favour of the evening's milk which is, however, more than counterbalanced by the increased yield in the morning.

Condition of constituents of milk.

The butter fat exists in milk as butter globules of various sizes easily discernible under the *microscope* The butter globules are of lower specific gravity than the other constituents of milk Consequently if the milk is set in a vessel the butter fat rises to the surface to form cream which can be separated by skimming In the milk the casein also exists in suspension in minute globules In fresh milk the casein neither tends to rise nor sink because it has absorbed part of the water of milk and is thereby softened and swollen, so that it is more evenly diffused through the water of milk The sugar of milk is in solution, the mineral matter is partly in solution and partly held in suspension It consists mostly of phosphates and common salt. The ash constituents are oxides of iron and alumina, magnesia, potash, soda, lime and phosphoric acid

Change by fermentation

Milk rapidly undergoes change particularly if the day temperature is high The changes are induced by bacterial ferments which thrive in the milk because it is almost a perfect food The most common change which occurs in the souring of milk is brought about by the

Milk Products. ([illegible]) | DAIRY Farming

MILK

conversion of sugar of milk (lactose) into lactic acid. The curdling of milk is an accompaniment of the lactic fermentation. This curdling may be accomplished artificially by means of an organic or mineral acid or, as in cheese making, by [illegible] the use of rennet. The active principle in [illegible] found in the fourth [illegible] It [illegible] but also [illegible] lactic acid cannot induce. The change of [illegible] only a molecular one and is due to the growth of the Bacterium lactis, an organism plentiful in the air of a dairy but particularly where the dairy is not kept scrupulously clean. Immediately milk is drawn from the udder it is subject to contamination. The chemical changes which then take place are directly caused by ferments induced by contamination. The temperature of the milk as it is drawn from the udder is just the temperature at which the reproduction of microbes takes place most rapidly. If milk is cooled immediately bacterial growth is checked and will not again become active until the milk slowly warms which it will do if the temperature of the dairy is higher than that of the cooled milk. If the dairy temperature is high, the milk will not keep long; if it is low the milk will remain sweet a considerable period. Milk which has been boiled and then rapidly cooled and afterwards kept in a cool clean place will keep longer than milk not so treated, but if the surroundings of the dairy are unsanitary, or if the dairy is within range of any unwholesome smell or other unhealthy influence, the milk is bound to become tainted in a manner which probably will make it dangerous for human food. Milk sours quickly in India during the hot season and also during the first part of the monsoon. During the early rains the atmosphere is close and sultry, and though the heat is not exceptionally oppressive, there is "thunder in the air", and any atmospheric electrical disturbance has a material effect in causing milk to sour quickly.

Causes of fermentation

Milk as it is secreted may be contaminated by deleterious substances in the food; moreover a diseased cow may yield milk which may be impregnated with disease germs and may therefore be the means of causing contagion, but as it leaves the udder it contains no fermentative bacteria. A few hours after milking the number of bacterial germs found in a cubic inch of milk is almost incredible, particularly if the temperature favours reproduction. The bacteria which cause fermentative changes in milk can be destroyed or at least their development and activity can be stayed in many ways.

Boracic acid, carbonate of soda and saltpetre are all used as milk preservatives, the first being the most effective. These agents do not destroy fermentative organisms, but only check their development.

Means of preventing fermentative changes

If the udders of the cows and the hand of the milker are clean, if the milk vessels have been thoroughly washed and well scalded, if the cows are milked in a pure atmosphere and if the udders are not inflamed

MILK.

or otherwise diseased, it is clear that the danger of organisms entering the milk is minimized.

But fermentative bacteria always exist in the air and it is practically impossible to prevent milk coming in contact with them; therefore other precautions to prevent fermentative changes are necessary.

Heat will kill all organisms in milk. If the heat applied is high enough, milk will be sterilized. Boiling will kill all bacteria. If boiled milk is kept out of contact with the air it will keep indefinitely. Preserved or condensed milk is prepared by evaporating milk to which sugar has been added until the mixture acquires the consistence of syrup. Whilst hot it is hermetically sealed in tins and keeps good for years. A high temperature kills the ferments of milk, a low temperature interrupts their activity if it does not actually destroy them. Milk, kept frozen, will keep good for months, whilst a mean temperature of 35° to 40° F. is sufficiently low to keep it good for days. A maximum day temperature of 55° F. will enable milk to be kept good sufficiently long to allow all the fat globules to rise to the surface. Whilst if the mean day temperature is 70° F. or higher the lactic ferment is so active that lactic acid is formed in sufficient quantity to curdle the casein in a very short time and the curdling entangles the butter fat globules so that they cannot rise to the surface. Milk sours so quickly in India that in order to get fresh cream the use of a De Laval Separator becomes almost compulsory.

Utility of the De Laval S

The separator will be found economical in other ways. By means of a separator the milk, so soon as it is milked, can be separated into its two prod

m and separated milk. The latter soon sours but the kept to ripen before it can be made into good butter of whole milk by mechanical power makes a large dairy unnecessary, for no room is required for the numerous vessels otherwise needed for setting the milk. If it is found necessary to raise cream by the ordinary milk setting process in India, the quicker the cream is made to rise the better the results will be, because even under the most favourable conditions it is improbable that all the cream can be skimmed off before the milk has thickened by turning sour.

Cream raising.

The loss can be avoided if the milk is maintained at an artificially low temperature by means of ice. Cream rises quickest in a falling temperature, and to expedite the process on practical lines in India I should recommend that shallow vessels be used, that these be placed in pans containing the coolest well water procurable, or that water be cooled specially for the purpose by allowing it to filter through a series of earthenware chatties. It is well known that if porous earthenware vessels are placed one above the other so that the water passes from one to the other, even though the temperature of the atmosphere is high evaporation takes place which lowers the temperature of the water so that, that which collects in the lowest vessel is comparatively cool.

MILK.

Cooling and aerating milk.

and is ordinarily of sufficiently low temperature to rapidly lower the temperature of new milk, provided the milk is set in its vessel in the water. This is a cheaper method of rapidly cooling milk than the use of ice. There is however one objection If milk is cooled below the temperature of the surrounding air, it will (like any other cold substance) condense the moisture of the surrounding air and along with this moisture it will absorb any taint or odour existing in that atmosphere. Impure air under these conditions will certainly injure milk The point therefore to be sure of is that the dairy is thoroughly ventilated and that the air which circulates through it is pure If on the other hand milk at a comparatively high temperature is exposed to air of a lower temperature the latter will certainly be the absorbent. These statements tend to show that the refrigerator in common use in dairies is of no great value The refrigerator is designed to aerate milk and at the same time to cool it The refrigerator is essentially a continuous tube ranged like a "worm" inside a frame. Cold water is made to circulate through the continuous tube whilst the milk passes as a thin film over the metal frame; the milk is cooled and at the same time is thoroughly exposed to the atmosphere so that the animal odour which invariably impregnates new milk is driven off It is at the same time thoroughly exposed to the oxidising influence of pure air This refrigerating process is employed to prepare milk for conveyance by road or rail in closed vessels to considerable distances and the milk is undoubtedly all the better for the treatment

The Refrigerator.

DAIRY EQUIPMENT

is stretched upon and tacked to the window frame, ventilation will be secured whilst flies and other insects will be excluded

The wash room with a built-in copper boiler should be a separate building

The dairy *for a herd of 20 to 40 milk cattle* should be *equipped* as follows —

	Rs	a	p
One Laval Separator "Alpha Baby" separates 30 gallons per hour, complete	360	0	0
Refrigerator with stand and fittings, complete, with two block tin drums or receivers	190	0	0
Six block tin pails	36	0	0
Two milk strainers, one fitted with wire gauze, the other with muslin	5	0	0
Two hair sieves	3	0	0
Sandringham Herd Recorder with pail and tripod with weighing milk	35	0	0
Iron scales with China pan for weighing butter	14	0	0
Temperature can	4	8	0
Thermometer	2	8	0
Half pint, 1 pint and 1 quart measures with hook handles	5	0	0
Victoria Churn (No 3) to churn 40 lbs of cream	85	0	0
[illegible]	45	0	0
[illegible] and one pair beaters for [illegible]	10	0	0
[illegible] and 8 oz pats of butter	[illegible]	0	0
Set of three cleaning brushes for churns, cans and separator	4	8	0
One gallon refined oil for separator	4	0	0
Total	806	8	0

CREAM SEPARATORS

Cream separators as now manufactured are simple and effective, and although protected by patents, which necessarily enhance their value are still moderately cheap They vary in size and price The hand power machines can effectively separate 30 to 40 gallons of milk per hour The larger *horse or steam* power *machines* separate 200 gallons or more The principle of all is the same The milk is fed at *a regular rate into* a cylinder which revolves at high speed The rate of revolution is so great that it exercises centrifugal force on the milk constituents The lighter cream forms itself into a column which occupies the centre of the cylinder whilst the heavier separated milk is thrown against the inner wall of the cylinder, each product escapes separately from the cylinder and runs through separate tubes into different vessels The De Laval "Windsor hand power machine is the one in most common use in India It separates 35 gallons per hour and costs in England £24

The "Windsor Separator how worked

For thorough separation the handle should be worked at a regular rate of 38 revolutions per minute, if worked at a higher rate, the cream comes thick, if at a lower rate, separation is not complete The driving power is obtained partly by cog-wheels and partly by friction pulleys The cylinder revolves on the latter If the friction pulleys

CREAM SEPARATORS

are coated with oil, the cylinder partly turns with and partly slips upon the friction pulleys, and therefore although the handle gets the correct number of revolutions, the cylinder does not turn at the proper rate which is about 6,500 revolutions per minute To safeguard against this error the friction pulleys should be rubbed free of oil immediately before starting the machine The separator should be set accurately level and fixed, so that it cannot be dislodged from its position All its parts must be kept scrupulously clean and the friction portions be regularly oiled with the purest lubricating oil obtainable Milk should be warm when undergoing separation The temperature at which it is drawn from the udder is sufficiently high. If milk is colder than 90°F before it is brought to the dairy, it must be raised to at least that temperature before it is separated This is specially necessary with buffalo milk which ordinarily is extremely rich in butter fat A temperature can, *i e*, a tin vessel with a tight fitting lid, and containing hot water, if dipped into milk and gently moved through it, will soon raise the temperature to the desired standard All milk before separation should be well strained first through a wire or hair sieve and then through muslin, a double-fold of which may be stretched on a strainer frame of ordinary form If the quantity of milk to be strained is considerable, both the wire and muslin strainers should from time to time, be rinsed in pure water as the 'straining' proceeds This should be done as often as there is any observable accumulation of foreign matter on the strainers

The products of separation.

Complete separation means that less than ½ per cent of butter fat remains in the separated milk It may be stated that approximately whole buffalo milk yields ⅓ cream and ⅔ separated milk, and that 2 lbs of the cream will yield from 1 lb to 1½ lbs of butter A pound of butter can be made from 9 lbs of milk, if rich, but it will take 16 lbs to make the same quantity if the milk is poor Buffalo milk is so rich in butter fat that the ordinary lactometer as graduated for use in England is necessarily misleading in India—thus it will indicate that separated milk is of better quality than whole buffalo milk To make this plain it may be stated that the lactometer will show pure milk when 8 per cent of water has been added to separated milk.

The Lactometer test misleading

BUTTER.

Slightly salted pure butter should contain approximately —

Water	7 5
Salt	1 1
Casein . . .	0 6
Milk sugar	0·3
Butter fat	90 5

Butter can be made to take up water to the extent of nearly 20 per cent The presence of a high percentage of water indicates that the butter has not been properly washed, because the removal of butter-milk and other impurities from butter implies not only

BUTTER

thorough washing, but thorough working or squeezing also. The process should not leave more than 10 to 12 per cent water in the butter. Imperfectly washed butter contains butter-milk and curd. The nitrogenous substance, casein, is highly fermentative and the presence in butter of even a small percentage causes the butter soon to turn rancid.

Rancidity induced by imperfect washing

Rancidity is believed to be due to a chemical change, *i. e.*, the splitting up of butyrine into butyric acid and glycerine. Air and light are necessary to initiate the change. The melting point of butter is of some importance. It is a means by which expert analysis can detect whether it has been adulterated with animal fat or vegetable oils.

The food which influences the quality of butter

The food given to dairy animals however influences the melting points. Those foods, which are least astringent, produce the softest butter. Cotton seed, pulse meal pea straw and other pulse fodders, also groundnut cake produce firm butter, whilst many oil cakes give soft greasy butter.

A simple test of purity.

A simple and homely method of detecting impurities in butter is to place a small piece in a test tube and plunge the test tube into hot water. The butter melts and separates into layers which will indicate approximately the relative proportions of its constituents. The clarified butter *(ghi)* will form the upper layer, the curd a middle thin layer dividing the *ghi* from the water which will occupy the bottom of the test tube.

Ripening cream

Cream after it has been separated from the milk is ripened in an earthenware jar, covered with muslin not with an air tight lid. During ripening the cream should be frequently stirred at least once every two hours. The time required to ripen cream depends upon the temperature. Cream will be sufficiently ripe in 12 hours if the temperature of the dairy is from 65° to 75°F., in less time if the temperature is higher. A greater period must elapse if the temperature is lower. During the early monsoon rains cream will ripen more quickly than in the hot weather. Cream is ripened with the object of making it yield a greater proportion of butter of finer flavour than that obtained from fresh cream. The flavour is believed to be developed by the growth of a microbe in the cream. The fermentation which proceeds during the ripening process causes the cream to thicken. Cream is not pure butter fat, for milk in variable proportion is always present and this milk sours as the cream ripens and the lactic acid precipitates the casein. The curd thus formed may during churning become incorporated more or less with the butter. Butter thus made will not keep long. If the sourness of ripe cream is excessive the curd forms in lumps, if the ripe cream is only *slightly* acid the precipitated casein breaks up into particles of minute size during churning and these particles always form a constituent portion of the butter milk which ordinarily by thorough washing can be separated from the butter. The butter which will keep longest is made from fresh cream whilst the butter with the finest flavour is made from ripened cream. The combination of keeping quality and flavour is a point of value. It has been authoritatively stated that

BUTTER.

this has been accomplished on the continent of Europe by inoculating fresh cream with a pure culture of the cream ripening microbe.

The ordinary method of hastening the ripening of cream is to add to it a little sour milk which, however, must be clean and free from any foreign taint or flavour.

Butter making.

Butter should be made in India in the early morning when the dairy is cool.

Ripe cream before it is churned should be cooled; 55°F. or 60°F. is the proper temperature.

The temperature of cream is lowered [illegible] cream *in its vessel* in cold water. The [illegible] the firmer the butter will be. The ch[illegible] times per minute. The best results are got when the butter comes in half an hour. If it comes much sooner it is probable that the cream has been over-ripened. If the cream is not equally ripe, *i.e*, if during ripening it has not been well stirred and thoroughly exposed *equally* to the air, that at the bottom of the vessel will be less ripe than that at the top, and in the process of churning the ripe or overripe portion of the cream will form into butter granules first. If this occurs a good deal of cream which has not been converted into butter will be removed with the butter-milk, and will be lost unless the butter-milk is kept for 24 hours, during which period the unchurned cream will rise to the surface of the butter-milk and may be skimmed off. In India a good deal of cream is recovered in this manner during the hot weather. Even under the most careful management some cream will be lost in the butter-milk at this season. The cream from buffalo's milk can be churned at a higher temperature than that from cows and yet produce equally firm butter. The feeding of the milch-cattle, as already noted, also influences the temperature at which firm butter can be churned. Colouring matter, if desired, should be added before churning. It is made from 3 oz. annatto seed digested for an hour in 8 oz. pure olive oil and then strained through fine muslin. One teaspoonful is sufficient for the cream of 40 lbs. buffalo's milk, *i. e.*, for about 4 lbs. of butter. Colouring matter, which is more concentrated, is made as follows: 4 oz. of ground annatto seed is put in a glass flask and just covered with rectified *spirit.* This mixture is allowed to digest for 7 days. The rectified spirit dissolves the colouring matter from the seed and a pure solution is obtained by straining through muslin. This solution is however unsuitable for colouring butter because the spirit would taint the butter. The mixture is therefore placed in a cooking vessel with 1 lb. of sesamum oil and carefully heated; the spirit is entirely evaporated and the solution is transferred to the oil. The colouring matter thus prepared is placed in a bottle when cool and kept corked to be used as required.

Loss of cream in the butter-milk.

Annatto colouring.

Cream should only half fill the churn. It is churned into butter by agitation. If the cream only half fills the churn the chief cause of

DAIRY Farming.	Milk and

BUTTER

agitation is due to the cream falling upon itself at each revolution of the churn; if it completely filled the churn there would be no agitation at all. If the cream is so thick that it sticks to the churn, pure cold water should be added. The lid of the churn is now fixed down and the churn turned at the rate already indicated. The cream will froth up and swell after the first few revolutions. The air which was incorporated with it is driven out, and because it is impure air and in consequence may taint the butter, it ought to escape through a valve placed on the lid of the churn for that purpose. A small pane of glass is inserted in the lid of the churn. By careful observation the dairyman can see from time to time what is going on inside, and can determine when the butter begins to form. So soon as this takes place cold water (about $\frac{1}{10}$th of the cream quantity) should be added. The object is to lower the temperature when the butter is forming in order to get it firm, also to dilute the butter-milk so that it may the easier be separated from the butter granules. The necessity of lowering the temperature arises because the agitation which the process of churning requires has raised considerably the initial temperature. The churning is again continued until specks of butter on the glass are

Churning

separate from the butter milk
ry to decide the right moment
oon butter is lost in the butter-
hat they pass with the butter-

milk through the meshes of the finest strainer. If carried on too long the butter granules aggregate and the butter becomes greasy; moreover it is difficult to separate the butter-milk completely by subsequent

texture of the butter
ter milk is drawn off
id is strained through

Removal of the butter milk and washing

a sieve, and any butter caught is returned to the churn. The churn is half filled with pure cold water and given a few more revolutions and then kept at rest for a short period. If curd is present in quantity, it will settle to the bottom of the churn whilst the butter floats on the water. As the water is drawn off the curd may also be removed. If curd is present the butter caught on the sieve should not be returned to the churn because it necessarily must be mixed with pieces of curd. If there is any considerable quantity it can be made into *ghi*. The chu

few more revolutions

as it is drawn off, and if

sieve are again returned to the churn. The butter is now comparatively free of butter-milk, but in order that it may be washed, as far as possible whilst still in a granular condition, brine is now added, the solution consisting of $\frac{3}{4}$th lb. salt to a gallon of water. The churn is again half filled and slowly revolved a few (say 3 or 4) times. The brine is drawn off and strained as before through a sieve.

Milk Products.—(*James Mollison*) | DAIRY Farming

BUTTER

The butter worker

The butter is now sufficiently washed to be removed from the churn to the butter-worker by means of two wooden scoops. The butter-worker is a simple arrangement whereby, in a wooden trough a grooved roller kneads the butter completely free of butter-milk. The butter milk escapes down the inclined plane which forms the floor of the trough and runs through a tap hole to a vessel placed to catch it below.

When thoroughly worked the butter is in a condition to be made up into marketable form. By the use of "Scotch hands" and wooden butter prints or moulds it can be made up at once into pats for immediate sale. If it is necessary to keep the butter any time it should be preserved with salt. One per cent. salt is sufficient to preserve butter in good condition for a few weeks whilst 3 to 4 per cent. salt will keep it good for months.

Salting

Fine table salt should be used. Before it is mixed with the butter it should be powdered very fine with a roller (an empty bottle does very well for the purpose). The salt should be mixed with the butter by thorough working on the butter worker, a little salt being sprinkled each time the butter is kneaded in the butter worker. I have proved that butter preserved in this manner if packed tight in earthenware "crocks" with tight fitting lids will in a comparatively cool place, keep good for months. Moreover, when required for use the butter can be washed almost free of salt by the free use of pure cold water and of the butter-worker. Improved dairy machinery is designed with the object of making it unnecessary for the dairyman to touch with the hands, either milk, cream or butter which in India is a point of significant importance.

CHEESE.

Curdling milk by rennet.

The principle of cheese making depends upon the casein of milk being artificially curdled by means of rennet. A small quantity will curdle a considerable quantity of milk. The casein entangles the butter fat globules and thus sinks separating from the whey. The whey contains the sugar the albumen and the greater portion of the ash constituents of milk, also a small proportion of butter fat. Whey is used in Europe chiefly in feeding pigs and poultry. The curd is manipulated in various ways to produce different kinds of cheese. The Cheddar system of cheese making is perhaps the most commom. Cheese varies in quality according to the quality of the milk from which it is made. It varies in character according to the system adopted in making it. The finest soft cheeses are made from milk, which has been improved by the addition of cream. Cheese made from pure milk is called whole milk cheese. There are numerous gradations of quality between cheese of this class, and that made from skimmed or separated milk. A good whole milk cheese will contain about equal percentages of casein, butter fat and water and about 2 per cent each of milk sugar, phosphates and common salt, the salt being added as a preservative. Cheese made from buffalo milk approxi-

Different qualities of cheese

Milk and

ESE mates Stilton in composition, which is a rich soft cheese usually containing about 27 per cent casein, 42 per cent butter fat and 23 per cent water

ances cheese The appliances required for cheese making are —

(1) A vat, in which the milk is set and curdled and the curd cut and "cooked

(2) A curd knife

(3) The curd cooler, on which the curd is exposed and ripened after it is removed from the vat

(4) The curd mill which grinds the curd into a granular condition before salting

(5) Hoops or moulds, in which the curd is squeezed free of whey The sides of the moulds are for this purpose perforated also the bottoms A round piece of wood fits loosely over the curd in the hoop and bears the pressure applied to express the whey and consolidate the curd

(6) The cheese press, to press the curd in the hoops The pressure is applied by means of a screw, assisted by an ingenious system of compound leverage which is increased as desired by adding weights, one by one

Cheese making in India only partially successful

Cheddar cheese has been made at Poona and at Aligarh in the North West Provinces, by Mr Keventer, a dairy expert It has so far been found impossible to make cheese of uniformly good quality in India The reason is that the temperature of the cheese room cannot be regulated, so that proper ripening of the cheese is ensured At Poona it was found impossible to secure in the curing room an even temperature of 65° to 75° F which, in order to obtain the best results, should be maintained with moist air The experience gained proves that cheese making can only be economically practised in those districts of India where the day temperature for a considerable portion of the year is moderately cool and where milk is produced at a cheap rate The industry cannot be advocated in any district, where milk is dearer than 30 lbs per rupee or where *ghi* (clarified butter) is worth more than 6 annas per pound

At Poona cheese was made from whole buffalo milk also from "reduced" buffalo's milk, the former containing about 6 per cent butter fat, the latter about 3 5 per cent The reduced milk was a *half and half* mixture of whole buffalo milk and separated milk and had almost identically the same composition as an average sample of English cow milk The best cheeses were made from whole milk

Vegetable rennet.

Cheeses made with [illegible] as well as those made from animal rennet, [illegible] us proves that an extract from the [illegible] s can not only coagulate milk but, digest and mellow curd into cheese The use of Withania rennet removes the cause of the Hindu objection to cheese,

Milk Products.—(*James Mollison*). | DAIRY Farming.

CHEESE.

and offers no disadvantages over the animal rennet which could not be overcome by care and experience. An overripe Withania cheese developes an acrid principle which gives an undesirable taste, whereas a cheese that is just ripe has a peculiar flavour which is not disagreeable. I have no doubt that the tendency to decomposition could be arrested by storing the ripe cheese in a cool, dry, well-ventilated room. It was observable throughout the Poona experiments that the curd from Withania rennet never developed the same desirable texture that the curd from animal rennet did; moreover the smell of the Withania was more powerful than the characteristic odour developed in the curd by a sufficient degree of acidity. Therefore an expert cheese-maker could not detect by his sense of smell when the curd became sufficiently acid.

Artificial colouring.

The blue white colour of cheese made from buffalo milk is not attractive and reduces the market value of the cheese. This of course can be rectified by artificial colouring which is more or less practised in all systems of cheese making. The unusually higher percentage of butter fat in buffalo milk gives a peculiar consistence to the ripened cheese. The curd remains somewhat granular during the ripening process and a clean slice cannot be cut with a sharp knife. This peculiarity is noticeable to a less extent in cheese made from reduced milk.

It was proved by the Poona experiments that in India milk can be coagulated and a quality of curd developed having the flavour and texture which ought to make a high class cheese, but the maturing of the cheese afterwards cannot be regulated to give the best results. The difference between the day and night temperatures was so great that it was impossible to maintain anything like an equable temperature in the curing room. The air, however, was kept sufficiently humid by sprinkling the mud floor occasionally with water.

Quality not uniform.

The quality of the cheese made was not uniform. This was probably due to intentional variations in the method of manufacture, in order to determine which method gave the best results. There were variations in the temperature of the milk when the rennet was added, and in the degrees of heat applied to the curd to create acidity, but the results were contradictory. The cheeses manufactured varied from fair to good, none could be classed as inferior. The best animal rennet cheese and the best Withania cheese were made from whole buffalo milk on the same day. Half the milk was kept over night, the other half was fresh. The temperature of the over-night milk was 70° F. at [illegible] it the cream was skimmed and adde[illegible] mperature of the mixture raised to [illegible] now added, and whilst being thoroughly stirred to ensure proper mixing, 80 lbs. were drawn away through a tap to be treated with Withania rennet in a separate vat. One hundred pounds remained. This quantity was coagulated

Details of method of manufacture.

CHEESE. Manufacture of

with animal rennet; 20 oz. of sour whey were added as a ferment to ripen the milk. Previous experience had shown that 1½ tablets of rennet extract was sufficient to coagulate 100 lbs. of milk in 45 to 50 minutes, and this quantity of rennet was used. It was dissolved in a little water and then added to the milk. The temperature of the milk was 86° F. The milk was well stirred to ensure complete admixture of the rennet, and was sufficiently coagulated in 50 minutes. Meantime the vat was covered with a cloth to retain warmth. The test of complete curdling is to pass a glass rod through the curd. If the curd breaks clean, coagulation is complete. The curd knife, which consists of a series of long sharp blades, set about ½ inch apart, was now gently used, first lengthwise and then across the vat, to cut the curd into sections. The curd slowly settled and got gradually firmer. The curd knife was now used more vigourously and the curd was minced into a fine granular condition. The cutting and stirring were continued for 55 minutes. The curd was then allowed half an hour's rest. Meanwhile a bucketful of whey was drawn off and heated. When the half hour's rest had lapsed, sufficient hot whey was returned to the vat to raise the temperature to 92° F. Curd and whey were [illegible] second rest of 30 [illegible] the curd, the te[illegible] half an hour a[illegible] was allowed. Sufficient acidity was now developed to permit the removal of the whole of the whey. The curd was now heaped up and kept warm by means of a cloth covering the vat until the proper flavour and texture were developed. In 65 minutes it was sufficiently acid to put on the cooler. An expert cheese maker detects by his sense of smell when curd has developed sufficient acidity Another test is when a piece can be separated without breaking by finger and thumb into thin sections. The curd was left to ripen on the cooler for 70 minutes, and then ground in the curd mill, salted with 2 per cent. salt, put in a hoop, previously lined with a cloth and placed in a press. The curd was kept under pressure, which was gradually increased for 3 days, being changed from its hoop and cloth daily. On the third day it was neatly bound and sown with calico, and placed in a shelf to ripen, being turned daily during the first week and at increasing longer intervals afterwards. This cheese was made on the 21st February and was ripe on the 16th of May. One hundred pounds of milk produced almost exactly 10 lbs. of cheese which had an excellent flavour and otherwise would not be objected to by an expert judge. A **Withania** cheese, made on the same day from curd manipulated as to temperature, &c., in almost precisely the same manner as described above, was ripe on the 7th of M[illegible]. In this case 80 lbs. of milk produced 7½ lbs of cheese.

Vegetable rennet decoction.

The **Withania** rennet decoction is made thus: 3 oz. of [illegible] solved in 2 lbs. of water and 6 oz. of powdered dry **Withan**[illegible] added to the brine. After digestion for 2[illegible]

strained through fine muslin One pound will coagulate 80 lbs milk in 50 to 60 minutes.

CHEESE.

Indian Churn

A native churn consists of a vessel holding curdled milk The curd is violently agitated by means of a beater The beater is made to rotate first in one direction and then in the opposite by means of a rope turned two or three times round its handle The free ends of the rope are held one in each hand of the operator and are pulled alternately

The vessels and plungers vary in size according to the quantity of milk dealt with Those used in households are small whilst those used by *gavlis* (professional milkmen) are large The vessel is usually an earthenware pot

The shape and construction of the plunger or beater varies Sometimes if small it is worked by rapidly rotating the handle between the palms of the hands

The beater of the Deccan churn consists of a wooden handle, on which a large head piece is fitted The head piece may be of iron or of hard wood It is cast or cut into a series of flanges and grooves and this irregular surface is well calculated to agitate the curd thoroughly The beater of the Konkan churn is very simple It consists of a piece of bamboo slit up at one end into four segments The segments are forked out and held so by two cross pieces at right angles to each other.

Native method of making butter

I note below the manner of making butter in a native churn with results from a given quantity of buffalo milk The quantity treated was 5 lbs The milk was boiled and then allowed to cool Whilst yet warm a small quantity of sour butter milk was added The milk curdled into a thick soft mass The curd was kept for 16 hours. Meantime the whey did not separate much The curd and whey were put into the churn and agitated for about 4 minutes This broke the curd up into a fine pulp Pure cold water about the milk quantity was now added The churn was again worked, and in about 12 minutes from the start butter began to collect on the surface A second smaller quantity of water (1 lb 4 oz) was now added and agitation continued for 4 minutes more. All the butter had now come to the surface It floated on the butter-milk and when the beater was removed from the churn vessel, the butter was deftly gathered off with the hand It was placed in a vessel which had previously been steeped in water, the wetness preventing the butter sticking to the vessel Some of the butter milk drained away, but the butter was not washed in any way [illegible] was soft, if it had b[illegible] ture it would have [illegible] less water and other impurity Seven and half ounces of butter were obtained This is equivalent to 1 lb of butter from 10⅔ lbs of

DAIRY Farming.	Milk and Milk Products.

CHEESE.

buffalo milk, or almost exactly the same proportion of butter to milk as that by improved methods. Butter churned from separated cream properly ripened is of course purer and more valuable and, moreover, the by-products (separated milk and butter-milk) are worth more than *ták* (native butter-milk). The comparative purity of butter made as above described with that churned from ripened cream is indicated by the under-noted percentages of *ghi* (clarified butter) obtained from each :—

Comparative results of native and improved methods.

Native made butter gave 77 3 per cent. *ghi.*
Butter made from ripened cream gave 81·2 per cent. *ghi.*

GHI.

Ghi (clarified butter) is generally made in an open brass or copper vessel over a slow fire. By the conversion of butter into *ghi,* the impurities are to a great extent got rid of. The water evaporates away whilst the curd settles and coats the bottom of the vessel. As the boiling proceeds the melted butter at first boils vigorously, by and by less so. The test of complete clarification is when the *ghi* almost ceases to bubble and simply heaves in the vessel. The clarified butter is then strained through a sieve into another vessel, in which, if closed to the air, the *ghi* will keep good for months or longer. *Ghi* is generally sold wholesale in large narrow-necked vessels made of hide, and varies in price from 5 to 8 annas a pound.

MA'VA.

Máva or *khava* is a favourite native product made from whole milk. It is milk dessicated and sweetened with pounded sugar. The finest variety is obtained from the new milk of buffaloes immediately after calving. This milk has a special value, because the sweetmeats made from it keep good for a year or longer. It has been proved that *máva* can be made from separated milk, the cream being saved for butter or *ghi.* The product is of course inferior to *máva* made from whole milk. In the market much of the *máva* sold is made from partially skimmed milk, and is sometimes admixed with flour. *Máva* made from separated milk is at least not inferior to this.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series; those on Forestry under the Forest Series, and those of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

THE

AGRICULTURAL LEDGER.

1895—No. 6.

DAIRY FARMING AND DAIRY PRODUCE.

(DICTIONARY OF ECONOMIC PRODUCTS, Vol. III., D. 15 a.)

MANAGEMENT OF DAIRY CATTLE IN INDIA.

Note by Mr. JAMES MOLLISON, *Superintendent, Government Farms, Bombay.*

Other DICTIONARY articles that may be consulted:

Butter, *Vol. I*, B. 983.
Dahi, *Vol. III*, D. 15.
Ghi, *Vol. III.*, G. 189.
Rennet, *Vol. VI*, *Pt I*, R. 73.

Other PAPERS that may be consulted.

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The objects of THE AGRICULTURAL LEDGER are—

(1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers,

(2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,

(3) To admit of the circulation in convenient form of information on any subject connected with agriculture or economic products to officials or other persons interested therein,

(4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

E C BUCK,

Secretary to the Government of India.

(Agricultural Series No. 13.)

THE

AGRICULTURAL LEDGER.

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DAIRY FARMING AND DAIRY PRODUCE.

[*Dictionary of Economic Products, Vol. III*, D 15 a.]

MANAGEMENT OF DAIRY CATTLE IN INDIA

Note by MR. JAMES MOLLISON, *Superintendent, Government Farms, Bombay*

Treatment of milch cattle

The constitutions of milch kine at time of parturition are delicate. Indian cows and buffaloes, although in a sense hardier than other milk breeds, are no exception to the general rule. Special care should at this time be exercised in providing suitable food and other comforts. If a cow or buffalo gives birth either during the monsoon or in the cold season, the animal must be protected from inclemency of weather. Experienced breeders will provide comfortable shelter during the wet days of the rainy season or the chill nights of the cold weather. A cool shady place will also be found for a newly calved cow in the hot season. A recently calved cow should not be turned out to pasture, in the blazing sun and high day temperature of March, April and May. This practice must be deprecated even in the cooler parts of India. During the time a pregnant milch animal is "dry," which unfortunately (especially as regards the buffalo) is rather a lengthy period, the cow should be kept in good, but not high condition. A good pasture, well supplied with pure drinking water and shady trees, will ordinarily maintain in calf cows in good condition. But when the natural pasturage fails, supplementary food of nutritive quality must be given. A full yield of milk during the next period of lactation need not be expected if the precaution referred to has been neglected. Beyond this a fairly liberal allowance of concentrated food must be allowed for at least six weeks just before calving. There is a very great variety of foods suitable and available for Indian milk cows. In the Deccan, *kadbi* (i e., *jowari*, Sorghum vulgare, straw) or hay of fair nutritive value, are the usual dry fodders, whilst various oil-cakes, cotton seed, *dal* (Cajanus indicus) husk (*chuni*) and wheat bran are the more common concentrated foods. Sesa-

B 1844—1

mum cake is perhaps the best procurable oil-cake *Khurásni* or niger-seed cake, though rather objectionable in appearance, is considered a safe and nutritive food Safflower or *Kusumbi* cake, although rather indigestible owing to the presence of a considerable percentage of fibrous husk has an advantage over other cakes, in that it can be bought at a season when it is cheap and thereafter safely stored It neither moulds nor turns rancid on keeping Cattle have to get accustomed to it, however before they eat it greedily Four to 6 lbs per day of equal weights of oil cake and bran, in addition to a fair allowance of dry fodder for the six weeks before calving, will keep a dry buffalo thriving Less will suffice for a cow A fortnight before calving, the quantity of concentrated food may, with advantage, be increased to 8 lbs per day The object is to supply the pregnant animal with concentrated food of a character which will not only exercise a slight laxative effect but will also improve the condition, so that free lactation may be expected soon after parturition If in good condition a full yield of milk forced by extra feeding will not debilitate the animal as would be the case if lean, when due to calve For a week after calving the feeding of the cow should receive close attention The food should be of a laxative character and should not be too rich Cotton seed, oil-cake and *chuni* (husk of Cajanus indicus) should be at this time eschewed There is no better food for a newly calved buffalo cow than a mash consisting of boiled *bájri* (Pennisetum typhoideum) to which has been added an equivalent weight of bran whilst the cooked *bajri* was still hot Five pounds each of *bájri* and bran will with the ordinary allowance of dry fodder, provide sufficient ration for a day Two oz of salt added to the mash will make it all the more palatable Good fresh green hay is at this time preferable to *kadbi* (*jowari*, Sorghum vulgare, straw) and if a limited allowance of green fodder, say 15 lbs per day, can be given, the ration will be improved Thus the ration for a day of a newly calved buffalo would consist of—

Rations for milch cattle before and immediately after parturition.

Food of milch cattle

8 to 12 lbs of good hay
15 lbs of green grass or other green fodder
5 lbs bran } as a hot mash.
5 lbs *bajri* (Pennisetum typhoideum) } as a hot mash.
2 oz salt } as a hot mash.

A cow should receive about ⅔rds of this ration

Immediately after calving a hot drink made up of a thin gruel or *Lápsi* of ground *bajri* and bran with a good handful of salt tends to cause the after birth to come away quickly

In Europe, deep milking cows are liable to milk fever which is most prevalent among heavy milking cows producing their 2nd or 3rd calf As a preventive, should there be any risk of milk fever,

the cow is drenched with linseed oil and epsom salts repeatedly during the week before calving. The practice, which does not seem to be necessary with Indian cattle, simply because they are generally poor milkers, is effective, because the laxative medicine keeps the bowels open and prevents any undue secretion of milk. Under the most favourable conditions an Indian cow or buffalo will not yield the full quantity of milk for a week or 10 days after giving birth. Then the full yield may be expected and ordinary food may be given. A buffalo in full yield requires to be specially well fed. I do not think, however, that any quantity beyond 18 lbs per day of concentrated food will increase the milk yield appreciably. A moderate sized buffalo giving over 30 lbs of milk per day (a quantity sufficient to make 3 lbs of butter) need not get a larger ration. Any extra quantity of food would be wasted. A large framed Jafferabad buffalo requires a larger ration than the smaller sized Surat buffalo, and moreover the former in the Deccan are less profitable, because they require a greater quantity of concentrated food and fodder to produce a given quantity of milk. Similarly a Gir cow, because usually of large size, requires to be more liberally fed than the smaller sized Aden. The latter I have found to give an equal yield of milk to larger breeds on much less food. It is clear that no hard and fast lines can be laid down regarding the feeding of cows and buffaloes in milk. An experienced stock owner will very soon determine the quantity of food that can advantageously be given to any one of his cows or buffaloes. With good management either a good cow or a good buffalo will, in India, milk up to the full capacity for four or five months after calving, and during this period there should be little or no change in the daily ration. A milch animal has a palate, however, and occasional variety in the food is often desirable. If milk cows are fed from month to month with precisely the same food they sooner or later may reject it altogether or eat it with less greed and relish. An occasional change in the ration is, therefore, expedient. For this purpose *dal* (Cajanus indicus) husk (*chuni*), if not regularly given, can with advantage be substituted twice a week for part of the other food and occasionally crushed linseed ¾ lb. per animal, per day, may be similarly given.

Quantity of food required.

Occasional variation in ration recommended.

A milk register will if carefully kept show at once when the milk yield begins to diminish. A daily record of the milk yield of each animal furnishes useful data. A glance at the figures will show when there has been any irregularity or disturbing cause to re-act on the milk yield. Moreover, if carefully kept, it is a true guide as to the value of different animals. One cow may milk well to begin with but the yield rapidly diminish. Another cow may yield steadily for a long time and be much the more valuable and profitable animal of the two, although producing at no time an abnormally high yield.

The milk register.

DAIRY Farming.

Management of Dairy

The milk register will also indicate whether the management of the cows has been good and moreover furnish data which will enable the farmer to discard one cow whilst he retains another because the latter has been proved to be the more profitable.

When the period of lactation has somewhat advanced and there is evidence of a lessening milk yield, the ration should also be diminished. It may be necessary to change the food at least once a month. The change will be regulated to some extent by the size and condition of the animal, but the main consideration is how much milk did the cow give during the previous month. An average buffalo giving 18 lbs. of milk per day and suckling her calf should have the ration noted below. I have found it both good and liberal :—

Dry fodder	15 to 20 lbs.
Cotton seed	4 lbs.
Bran	4 lbs.
Oil-cake	3 lbs.
Chuni (husk of Cajanus indicus) ...	3 lbs.
Salt	2 oz.

Feeding.

The cotton seed, *chuni* (husk of Cajanus indicus) and bran with salt added should be moistened. The oil-cake, broken into pieces, at most an inch in diameter, may be placed on the top of the moistened mass but not mixed through it. The concentrated food should be given in two meals and at milking times. This is perhaps a bad practice which, however, cannot be avoided. Indian buffaloes and cows have been so accustomed to get the food whilst being milked that without it they refuse to let the milk down. The enjoyment of eating doubtless induces a placidity of disposition at the time which permits the *gavli* (milkman) to milk rapidly and extract more milk than he otherwise would, especially from those animals which are unusually irritable and fractious. Two-thirds of the dry fodder should be given at night, the remainder in the forenoon. The cows should be milked at regular stated hours, and there should be no deviation therefrom under any circumstances : 6 A.M. and 5 P.M. are suitable hours. The concentrated food is usually given in two equal meals at these times. [illegible] to pure water three times a day. [illegible] shed at least once a day. During [illegible] vailable the dry fodder may be reduced to 6 to [illegible] the concentrated food reduced by ⅓ or if green [illegible] able quantity all the year round, it may be [illegible] A large buffalo may be allowed up to 40 lbs. per day of green food, and 6 or 8 lbs. of hay in addition, together with the concentrated food ration already noted. Usually 15 or 20 lbs. of green fodder per day is all that can be allowed. This quantity may be substituted for 8 or 10 lbs. of hay.

Cattle in India (*James Mollison*)

DAIRY Farming

Drinking water or succulent food given immediately before the animal is milked is believed by the *gavli* (milkman) to increase the yield of milk. The quality necessarily must be lowered in a corresponding degree. A native will, when he sells a buffalo guaranteeing a certain milk yield, invariably allow the animal to drink freely before proceeding to milk. It is possible that the milk yield may be affected in this way, for succulent food undoubtedly lowers the percentage of total solids in milk by making it more watery. In 1892, at the Poona Government Farm, during the hot season 10 lbs buffalo milk on an average yielded a lb of butter, whilst during the following rains when a good deal of the food was succulent, the average was 1 lb butter from 12 lbs milk. During 1893 it was found possible to feed during the whole year a *limited* quantity of green fodder, and the difference previously marked was not so noticeable although still appreciable. The actual figures were: during February, March, April and May, the average quantity of milk required to produce 1 lb of butter was 11 lbs 7 oz., similarly for June, July and August, the average weight was 12 lbs 8 oz.

Quality of milk affected by food.

The quality of the milk is in other respects influenced by food. Thus cream from milk of buffaloes, largely fed on oil cake, will churn into greasy butter even if the temperature of the cream in the churn is lowered artificially to the most favourable point. Cotton seed tends to produce fine firm butter, and the cream can be churned at a comparatively high temperature. The cream from cows fed largely on *chuni* (husk of Cajanus indicus) gives butter which has a nice flavour and a better colour than usual.

When green fodder is given in fair quantity cotton seed and *chuni* (husk of Cajanus indicus) can be fed to any reasonable extent. If otherwise the allowance of each should not exceed 4 lbs per day. Lucerne is not a good fodder for milk cattle in any quantity beyond 10 lbs per day. *Jowári* (Sorghum vulgare) should be well in flower before it is cut as green fodder, otherwise like lucerne it has a tendency to cause tympanites.

Precautions to be observed in feeding.

It is quite possible to over-do the feeding of milk cattle. A cow in milk should not be in high condition. An animal in very high condition will give very little milk, and this probably accounts for a common practice with *gavlis* (milkmen), *viz.*, to give a less quantity of food to fat animals so that the milk yield may increase.

Feeding may be over-done.

Indian cows and buffaloes are so excitable and irritable that a very trivial circumstance often affects the milk yield. Its secretion is influenced to a very great extent by good management. If the calf dies, the milk yield may be diminished permanently. There is an Indian proverb, the English rendering of which is "soil without manure is like a cow without her calf." Any sudden change

Mismanagement and results thereof

or green grass. A handful of mixed *chuni* and bran (about ½ lb. per day) in two meals is all that is required at first. The quantity may gradually be increased until, when 8 months old, 1½ lbs. per day should be allowed. On the ordinary milk ration of Indian calves, large framed English calves would literally starve. When a calf is raised by hand it has to be taught to drink. Its instinct is to suckle and this is taken advantage of in giving the first lesson. If sufficient time after birth is allowed, the calf gets hungry. It will suck one or two fingers of the right hand if introduced into its month. If at the same time the head is forced gently into a vessel containing the milk so that the muzzle just reaches the milk, the calf will soon learn to drink. The first milk is drawn into the mouth unconsciously and swallowed in the act of sucking the fingers. The important points to be attended to in rearing hand-fed calves are that the milk and food should be clean and fresh and of course given in a clean vessel. Sour milk or milk tainted in any way is apt to produce diarrhœa or scour. Well ventilated and well drained accommodation for calves is necessary. All excreta should be removed at least twice a day. The droppings from calves, fed on milk, soon acquire a most disagreeable smell. Any unsanitary condition tends to cause scour. Over-crowded calves never thrive. They are subject to be attacked by parasitic vermin and skin disease, especially ring-worm and itch. A piece of rock-salt should be placed so that the calves can lick it. If a hole is bored in the lump and the lump is suspended by a string, none of the salt is wasted. A lump of lime or chalk placed within reach will also be regularly licked. The chalk is beneficial, because it has a tendency to counteract that acidity in the stomach which always accompanies scour.

Management and feeding of young stock.

If proper attention is given to the feeding and management of calves during the first few months of their life and if satisfactory progress has been made in growth during that period, they will continue to thrive often with much less care and with much less food than a young animal which has previously been half starved, and this remark is applicable to all animals. If young stock are to make satisfactory progress, even in India, a certain amount of shelter is necessary. The monsoon is decidedly the most trying season. Roomy yards with shelter steading must be provided to be used during excessively heavy rain. Grazing ground gets so soft and so easily puddled that any attempt to turn young stock out to graze would be alike harmful to them and to the pasture. In India the conditions associated with the rearing of young stock are different from those found in other countries. There is in India grazing of a sort all the year round. The grazing is not equally good at all seasons. Usually there is only green grass for 5 or 6 months and the natural food must afterwards be supplemented by other food. The daily ration must be especially liberal at those seasons when the natural food is scarce.

Cattle in India. (*James Mollison*)	DAIRY Farming.

Super-abundance at one season and semi-starvation at another is a fruitful cause of loss. Particular care should be exercised when young grass begins to grow. It flushes up very suddenly in India The first grow
not
give
change of feeding is so sudden that impaction of the stomach is induced. The innutritious fibrous food previously given collects in the rumen and becomes impacted, whilst the green food passes through the alimentary canal without being properly digested. The first symtom is that the animal scours. Young stock should be prepared before they are turned out to grass. Linseed cake is a useful food at this season on account of ...ffect on other food with which
digestion ; but linseed cake is
ke rich in oil and free from
fibrous matter, for instance sesamum cake, should be fed to all young stock for at least a fortnight before they are turned out to grass, 2 or 3 lbs. per day along with the usual ration of dry fodder will prevent the serious consequences which would follow a sudden change from dry fodder to green grass.

Indian cows and buffaloes irregular breeders.

Indian cows and buffaloes are at the best irregular breeders. Some breeds are more irregular than others Gir cows are very unsatisfactory in this respect. On the other hand, Aden cattle if well fed, will come in season for the bull six weeks or 2 months after calving. Buffaloes are less regular than cows Green food given in moderate quantity all the year round tends to bring cows and buffaloes sooner into "season' after calving This would be the case even although the animals are otherwise well fed A bull turned out to pasture with the cows periodically, say once a week, and especially a buffalo bull with buffalo cows tends to bring them into season sooner than would otherwise be the case The following tabular figures show the average period of lactation and the average time between two successive births of the cow herd and buffalo herd on the Poona Farm in 1893 :—

Average period of lactation.

	Average period of lactation. Days	Average period between two successive births. Days.
Whole buffalo herd	364	524
Whole cow herd .	360	475

The longer period between births in respect of buffaloes arises partly because buffaloes are longer pregnant than cows

Period of gestation.

Buffaloes are in the average pregnant	315 days
Cows	282 „

An old cow will carry a calf 10 days or a fortnight longer than a heifer and a cow bearing twins will usually go 272 to 275 days

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series, those on Forestry under the Forest Series, and those of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

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ONGOLE OR NELLORE CATTLE.

Note by VETERINARY CAPTAIN H. T. PEASE, F.Z.S., *Assistant to Inspector General, Civil Veterinary Department, Meerut.*

Other PAPERS that may be consulted:

Agricultural Ledger, No. 19 of 1893.
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ONGOLE OR NELLORE CATTLE

Note by VETERINARY CAPTAIN H. T. PEASE, F Z S., *Assistant to Inspector General, Civil Veterinary Department, Meerut.*

Description.

The cattle bred in the districts of Nellore and Kistna, known by the name of "Ongole," have from early times enjoyed a wide reputation as milkers and for slow heavy draught They are only found in perfection in the Ongole and Kandukur taluqs of Nellore and the Rajapett and [illegible]

in a few particulars

The Smaller Cattle—have short legs and are more compact and hardy These qualities come out prominently when they are located in hill districts, for which they are well suited They are also the better milkers of the [illegible] ed under [illegible] and, as a [illegible] y do not [illegible] yet they are universally recognised as belonging to one of the best milking breeds

Nellore cattle [illegible]

horns are short and stumpy, and in well bred animals are from 3 to 6 inches in length, but in others reach to 12 inches or more They are generally slightly longer in the cow and more pointed · in position they incline outwards with a decided tilt backwards terminating in a more or less blunt point They give to the head a very curious and characteristic appearance, the bulging forehead forming a very obtuse angle. The eyes

OXEN.	Ongole or
Description	are large and mild, face, short and fine; forehead size, slightly drooping. The and moderately so in the c sionally dipping, loins wide but slack; tail better set on than usual in Indian cattle, and not too coarse nor long, fair depth and width of chest; carcase heavy; dewlap large and heavy and continued by loose skin under the chest. The limbs strong, massive; feet soft and large. The cow is more slightly built; the head light and fine; dewlap fairly well developed; carcase well shaped; and there is a fold of skin running forward from the udder. The prevailing and true colour is white with black points, and frequently the bulls are black about the . "They are noble a in the breed to gro hey are good animals draught, and when well bred they draw heavy loads from 1,500 to 2,000 ℔ on a fair road. In point of size the variety is inferior to the Guzerat or Nagar cattle. Though the bullocks are sought for on account of their size, they are not good cattle on hard land, being soft and having bad feet They are too slow and heavy for trotting, and their chief use is for agricultural draught. The following are the measurements of some ordinary cattle of the breed:—

Measurements, etc., of the Nellore breed of Cattle.

Sex.	Age.	Height at shoulder.	Height at croup.	Height at elbow.	Length.	Length of horn.	Length of ear.	Length of face.	Breadth of forehead.	Girth at chest.	Girth at abdomen.	Girth of forearm.	Girth of shank.	Length of neck.	Length of shank.	Colour of skin.	Colour of hair.
Cow .	13	51	56	31	69	13	9	23	9	69	81	12	8	21	8½	Brown	Red.
" .	10	52	54	29	71	12	8½	20	8	66	76½	13	9	15	8	Black	Grey-white.
" .	6	49	53	27	63	7½	8½	21	8	62	72	12	7	14	9	Do.	Do.
" .	13	53	54	27	70	13	8	22	8	66	75	13	6	16	8½	Do.	Do.
" .	12	51	54	27	70	13	9½	23	9½	66	75	12	6	15	8	Do.	Do.
" .	10	47	50	24	62	10	7	20	7	63	70	14	6	16	8	Do.	Red broken colour.
Bull .	9	54	58	30	69	7	9½	23	10	70	77	12	7½	18	9	Do.	Iron-grey.
" .	9	53	59	31	66	16	9	24	10	74	82	15	8	20	8½	Do.	Do.
" .	11	58	60	33	73	9	9½	24	11	73	80	15	7½	19	8½	Do.	Do.
" .	11	58	61	30	77	10	9½	24	12½	74	81	15	8	20	8½	Do.	Do.
" .	7	54	55	31	66	5	9½	23	12	68	72	14	7½	18	8	Do.	Do.
Bullock .	8	55	57	29	67	9	9	23	9½	67	72	13	7	18	8½	Do.	Do.
" .	8	54	56	27	75	9	8½	23	9	65	63	12	5	24	8	Do.	Do.
" .	10	53	54	28	67	12	8½	24	10	70	71	13	7½	20	8	Do.	Do.
" .	10	55	56	28	75	9	7½	23	9½	71	76	14	8	21	9	Do.	Do.

(MR. BENSON.)

OXEN.	Ongole or

Number of Cattle.

Early Celebrity—It has been remarked that cattle breeding generally receives most attention in those countries where circumstances of one kind or other are adverse to the extensive prosecution of agriculture Mr. Travers in the first settlement report of this district for Fusli 1211 (1801-2), remarks the superior quality of the cattle and thus accounts for it :—

"Having been repeatedly deprived of their cultivation when brought to maturity, experience pointed out to the inhabitants of these districts [illegible]

they secured from the grasp of renters by moving them from their own to neighbouring villages, that from the system of petty renters were generally under a separate authority

"From this cause a large portion of their cultivated lands have been appropriated to pasture, and the fear of my interference therein is one cause to which I ascribe their anxiety to keep me ignorant of their extent, as also a supposition that by my immediately forming rents upon such accounts as I could obtain, they would embrace this favourite pursuit with other advantages resulting from my ignorance in this respect"

From a return sent by Mr Travers to the Board of Revenue on 16th June 1803, the number of horned cattle were stated to be—

Nellore	237,931
Ongole	54,474
	292,405

Used for Tillage

Nellore	60,789
Ongole	11,192
	71,981

Employed in carrying grains, etc.

Nellore	1,789
Ongole	318
	2,107

Of the remaining

Nellore	175,353
Ongole	42,964
	218,317

There were—

	Bulls	Cows	Bullocks	Calves.
Nellore	488	161,432	302	13 081
Ongole	63	39 567	47	3,287
	551	200 999	349	16,368

Total cattle fit for draught or carriage (i e, grain-carriers, bulls and bullocks).

Nellore	2,579
Ongole	428
	3,007

O. 551—94.

Nellore Cattle. (*H T Pease*) | **OXEN.**

The great apparent preponderance of female stock is probably to be accounted for by supposing the villagers to have given false returns of ploughing cattle and bullocks, in order to conceal their resources for cultivation In fact all the totals are probably under the mark

Cattle shows.

Cattle Show at Addanki —With the view to encourage the breeding of good stock an annual cattle show has been established by Government which is held every year in January at Addanki, though one year it was removed to Ongole. There is also another cattle show with an exhi- [illegible] n [illegible] y Governmen[illegible] the perso[illegible] tunity of [illegible] his own an[illegible] the amour[illegible] though the appearance of the animals showed that the people had generally produced the finest specimens of the breed of the two districts (Nellore and Kistna), there was an exception in the case of cows, and the full prize allotted in the programme was withheld as no specimens of "the old breed of heavy cows for which both districts were once celebrated had been brought forward" There was in fact, "some doubt whether this class of animals is still to be found among the people, owing [illegible] rally purchased to send away from the [illegible] the ryots, to a succession of bad grazing [illegible]

In 1860, the prize list, with other expenses amounted to R900, and it was remarked that the finest animals shown were 'among the two year old, which had certainly been bred since these shows commenced"

In 1862, steps having been taken, calculated to overcome the scruples of the ryots in exhibiting their cows, a recommendation was submitted for additional prizes for heifers The Committee who adjudged the prizes this year remarked on the progress that had been made in breaking through prejudices that had hitherto interfered with the show, and they observed that it was "a fundamental principle with the breeders of stock that the improvement of cattle depends as much, if not more, in the amount of care bestowed on the rearing of the cows as of the bulls," In forwarding to Government a recommendation on the part of the Committee that an additional sum of R200 should be granted as prizes for the furtherance of this important object, Mr Dykes brought to notice that the Nellore cow is usually four years old when she gives her first calf

In 1863 R1,250 were allotted for prizes and a gold ring was given by the Governor, Sir William Denison A true direction was marked out for the efforts of the exhibitors, and in 1864 good progress was made

In 1865 Sir William Denison himself attended the show at Addanki It was remarked that the number of cows and heifers was particularly satisfactory, though relatively they were greatly inferior in size and appearance to bulls of all ages Special encouragement, it was, therefore, determined by Government, should be given to the rearing and feeding of cows and heifers (G O, 1st March 1865, No 531).

In 1866, the prize list was raised to R1,600, of which nearly one half was for cows and heifers, R700 against R200 previously, and in this year so satisfactorily were the prejudices of the ryots overcome that the cows and heifers formed the greater proportion of the animals exhibited

OXEN.	Ongole or

Results of Cattle shows

In 1867, the Committee remarked on the four-year old heifers being a remarkably fine show.

In 1868, though there was a falling off in the total number of animals exhibited, the Committee commended on the marked increase in the number of the youngest stock brought forward to compete, and the progressive improvement of the heifers

The show of 1869 was particularly good. The following remarks of the Board of Revenue [illegible] 1869, were made upon the report of [illegible] of young stock, was very [illegible] was eminently successf[illegible] exhibitions are exercisin[illegible] year has shown increasing attention devoted to the care of breeding cattle, and whereas at first but few cows—and these of inferior description—were brought forward, the main feature of the exhibition now is the superior, well fed and well-cared for cows, heifers, and calves Till recently the attention of the local breeders seems to have been concentrated on their male stock, and the contrast at the early shows between the magnificent bulls of all ages and the puny cows from which they sprung was most striking.

"One most important result of the care which since the institution of these shows has been taken of breeding stock is the earlier age at which the cows begin to bear"

In 1870, the cattle show was held experimentally at Ongole instead of Addanki In consequence of the change, fewer cattle than usual were brought from the Kistna district to compete The Committee stated in their report their belief that the show of cows and heifers was superior to any previous collection A special prize of R50 was offered by Mr Dykes, who had left the district, for the youngest well-bred cow under four years of age, with calf at heel, but no cows of three and four years old were exhibited, though there were 27 heifers of this age brought to the show stated to be in calf The Committee remarked "In the number and quality of young bulls there has also been a marked improvement y[illegible] ir and five-year [illegible] or three years, c[illegible] also doubts as to whether there has been a great improvement in the class of working bullocks With regard to the number of cattle exhibited of all kinds, there has been a gradual increase annually, and this year upwards of 300 were on the ground—a total much in excess of any previous gathering" The sum expended in prizes was R1,650, the chief change in the prize list being that ponies are excluded and three and four-year old heifers included

In 1871, the cattle show was again held at Addanki, but the Committee did not consider the show altogether a successful one The prize animals indeed they considered to be quite up to the mark of the previous year and in the quality generally of the cattle on the ground no falling off was noticeable, but there were only some 250 head against 300 in 1870 A most encouraging feature of this show was the class of four-year old cows There was, however, no cow under four years old with calf at heel to compete for Mr Dykes's prize, which was awarded to the best cow in the four-year old class Mr G Vans Agnew, the present Collector in sending up his report, offered these remarks with regard to the effects of this annual cattle show —

"My experience of Indian Agriculturists renders me altogether sceptical in regard to the possibility, within any definite period, of influ-

bulls range from R70 to R300, bullocks from R70 to R200, cows from R50 to R200 In other parts of the district bulls and bullocks from R20 to R80 cows from R15 to R30 The prices of buffaloes range from R5 to R30, a higher price being usually fetched by she buffaloes

Pasture Tax

The *pullary* or pasture tax, one peculiar to the Nellore district, was found in existence here, when the district came under British rule, under four different forms —

I —*Makta Pullary* —A grass money assessment levied on the total common pasturage of a village and modified with reference to occupation out of the waste land for cultivation

II —*Amanat Pullary* —An addition made to the so modified tax on account of additions to the waste by lands thrown out of occupation, but within the original maximum

III

IV

By Government Order, dated 13th November 1867, No 2676, Land Revenue Department, the pullary tax (

principle laid down for the future that out

an extent equal to 30 per cent of the area

in future be reserved for common grazing free of charge and that the surplus waste if sufficient in extent to make it worth while to adopt the system, be leased out for one or two years at a time to the highest bidder, it being of course understood that no land will be kept waste for grazing if sought for

consist of fair

the villagers

always been let out in lots, are not affected by these orders. The abolition of the pullary tax has been regarded as a great boon to the district, because cattle-breeding on a superior scale and system is here a special industry

Distribution of Nellore cattle

Districts depending on Nellore for Cattle Supply —The Nellore cattle supply is relied on by the ryot of the black cotton soil plains of Bellary, Kurnool and Cuddapah, where practically no cattle are bred This supply is kept up by drovers who annually visit the districts named with strings of young bulls of from 18 months to 2 years of age They never bring any other stock with them They travel through the country and sell young bulls in every village and are paid by instalments, usually spread over three years, and generally collected without difficulty or litigation

Mode of rearing.

General Management —The herds made up of cows contributed by the ryots of one or more villages are sent for pasturage about July to the large forest areas in the hilly country adjoining and are generally accompanied by one or two bulls, they remain in the jungles until the harvest is over, by which time the grazing in the hills is very scanty, and then return to their villages Whilst they are in the hills they are left in charge of a few men who drive them to and from the jungles and pens The bulls accompanying the herds are "swami" (brahmani) bulls belonging to no one

Calves are dropped at all seasons and are usually reared in the villages No calves or very young stock are sent to the forests with the herds of cows

Besides forming the supply of cattle for the districts mentioned, this

breed is largely used in the Kistna district especially in the upland taluqs of the south.

Yield of milk.

Yield of Milk —The milk yield is good Some of the best cows have been known to yield 18 quarts and rear a calf at the same time. Two cows at the Saidapet farm when in full milk yielded about 84 measures. per month.

Pasture for Cattle.

Pasturing of cattle.

The system observed by the ryots of the different parts of the district depends, in some measure, on the extent of pasture land there may happen to be in the vicinity of the village In the wet villages, with little or no unoccupied area available, the greater portion of the dry land is often held by the ryots on *puttah* as pasturage for their cattle On the other hand, in villages where any large extent of waste may be available and common to the whole of the villagers, such as scrub and fair jungle which affords good grazing, land will not be retained on puttah or reserved as pasturage To describe the pasturage system of the district, it is requisite to refer to the several taluqs in order, and to specify the course generally pursued as regards each In the southern and coast taluqs of Nellore and Gudur it is usual throughout the wet villages f [illegible] to be sent from [illegible] and can be secure [illegible] may be under dr [illegible] thus generally leaves the [illegible] and are sent sometimes [illegible] but more generally to the [illegible] Rapur The cattle of [illegible] away to the jungles to the south of Kavali and in the western parts of Atmakur and Udayagiri Part of the working cattle will occasionally follow the other cattle to the jungle during November, or else in early December, should the available pasture land in the village not suffice for the whole number The ryots often club together and send their cattle away in large herds, either one or more according to the size of the village and the number of herd of cattle For this purpose, prior to the departure of the cattle from the village, the requisite arrangements are effected for renting a pasture farm for a fixed sum for the season, or [illegible]

herds being [illegible] out many [illegible] cattle are [illegible] wet land and [illegible] animals be [illegible]

OXEN.	Ongole or

Pasturing of cattle.

The working cattle which remain in the villages are grazed in the waste lands and such occupied dry land as the ryots may hold and set apart for grass. Pasture land of the latter description is generally reserved for a month or two and kept clear of cattle till the grass is well up. During the time they are thus stationary in the village the working cattle are fed more or le[illegible] well, and this may be said to be co[illegible] he bulk of the *cattle obtain fair grazing* [illegible] during April, but from May, as the hot weather fairly sets in and every blade of grass disappears, straw is given to the ordinary cattle or cows also, as well as to the working bullocks, and the whole are generally folded at night in the fields. As a little grass springs up with the early rain, the paddy straw is more or less reduced until the bulk of the cattle depart once more to the grazing lands consequent on there being no g[illegible]er part of the land [illegible] cattle whilst away [illegible] or full-grown stock, and the *balla* and pa[illegible] are calculated at 8 annas a head, or R[illegible] round for each full grown animal [illegible]s are ordinarily taken as equal to one full-grown animal when reckoning the number of head. Throughout the greater number of the villages of Rapur, Atmakur and Udayagiri there is sufficient area of jungle waste for the cattle to graze on throughout the year, and in many villages of Rapur and the western parts of Atmakur and Udayagiri large tracts are available for the cattle of other villages and taluqs In the villages of the above mentioned western taluqs, where there may be merely sufficient grazing land for the cattle of the village, it is usual for the cattle to be grazed therein from the commencement of the rains in June or July, when the grass will revive and once more spring up, and for them to continue to be thus pastured till February. The whole of the jungle waste is not open to the cattle at all times, for, after the heavy burst of rain, invariably experienced about [illegible] kept clear o[illegible] grown up we[illegible] thereon so lo[illegible] then another portion being similar-ly set apart fo[illegible] indifferent part of the [illegible] o the whole [illegible] working cattle du[illegible]g the early [illegible] be dug and given green, and they [illegible] as there will be little pasture, until turned into the reserved lands during November and December. Should the rains continue late the pasturage will prove fair till February. Towards the end of J[illegible] have come into ear, the younger shoots [illegible] removed and given to [illegible] close to the *jonna* field[illegible] After the working cat[illegible] [illegible]ed about February and March, the whole [illegible] of the *jonna* [illegible] working stock [illegible] fields become [illegible] crub jungle to find what they can in the shape of leaves, and this slight provender is eked out with a little *choppa*, the working cattle being meanwhile housed

In the village and almost wholly fed on *choppa*. In parts of Rapur Atma-kur and Udayagiri, where there may be a lack of scr... nary cattle are sometimes sent away to the Velligondah and adjoining hills both in this and the Cuddapah district, the Velligondah hills being the line of boundary between the two districts. Cattle thus sent for hill grazing are generally absent from their villages ... June and July. In Kavali there ... in the central portion of the ... afford pasture for a large numbe... instances, where the jungle waste of the village may be slight, the cattle are sent to the jungles in the extreme south of the Kandukur taluq. The mode of pasturing is similar to that already described for the foregoing taluqs.

Throughout the Kanigiri taluq there is but a slight extent of really fair grazing land, and very little more than indifferent scrub jungle, almost the whole taluq being excessively stony and very bleak and barren. The cattle are few in number, and are mostly fed within the village. When the early rains set in ... w and again sent to the Veligon... e boundary with Kurnool, or to ... should they be very badly off ...

In the Kandukur taluq, varying systems are met with. The system prevailing in the southern and coast villages assimilates to that of the neighbouring villages of Kavali; whilst in the northern villages or those under the influence of the south-west monsoon, where the principal crops may be *peda jonna* and *variga*, and there is hardly any waste land common to the villages for grazing, and, moreover, no jungle at all as a rule, it is usual for each ryot to retain part of his holding or puttah land as pasture. In a great measure this is permanently done by putting and keeping under grass land bordering on streams or cut up by water courses, or land lying low and liable to be ... Land fallowed by temporary cultivation of trees.

... and trees are ... to some extent; and when finally cleared away, are of considerable size and value, wood of any description being very scarce. The trees shade the ground and favour the growth of the grass, and the pods they yield form good fodder for cattle and sheep. The pasture land held in this way is invariably distinct for each ryot, ... generally ... in milk. ... in milk an... ing season ... zamindary ... the Kistna ... cattle and ... lands set ... each ryot; and, during the rains, the working cattle are also fed with the husk and refuse leaf of the horse gram plant after beating out the grain, and likewise with that of the *pessara*, *minuma*, *kandi*, and Bengal gram plants, which are carefully stored for the ... se from the *jonna* cobs is similarly pre... and, during the height of the ploughing ... with grain either *jonna* or horse gram

Cattle-food.

or else with cotton seeds. The *jonna* is usually bruized and boiled, and the horse gram and cotton seeds bruized and soaked only. As the *korra* crop is threshed out during November, the straw is generally used up at once and not stacked, and after the *jonna* crop comes into ear, or early in the above month, the "*sadu*" or young suckers, not likely to mature, are gathered for the cattle and given green During December the *jonna* is harvested, but owing to the *pessara* and *kandi* growing in the same field as the *jonna*, the cattle cannot be turned in; and often the *jonna* thus left will shoot up vigorously a second time and is now and again allowed to mature, but more generally it is plucked green and given to the cattle These new shoots are termed "*Namu*," and after the *pessara* is gathered in January and the *kandi* in March, very fair feeding for the cattle exists in the *jonna* fields Meanwhile, during January the *variga* harvest will have been mostly completed, and the *jonna* and *gongura* sown in the same fields will also have been eaten down for the most part by the cattle As the hot weather sets in early in April, *pandals* are run up open to the east, but well enclosed to the west, to afford cover and protection to the cattle from the sun, and west or land wind. These *pandals* are formed of the stalks of the *kandi*, lamp oil, cotton, and chilly plants. The same material is used to construct the walls of the sheds in which the husk and refuse leaf of the horse gram and other plants, already specified, are stored for the cattle during the rains As the walls of the sheds are run up, the husk is filled in, and the whole is thatched in with *sazza* straw. The straw stacks are generally on the same spot, and are fenced off The working cattle are thus well cared for during the day, and at night are folded in the fields The whole of the cattle are fed on *jonna choppa* during the hot weather, and until there may be sufficient pasture, or the cows, etc, may leave for the distant grazing lands in other parts In Ongole the cattle are particularly well cared for and fed, and a fair number of young stock and cows are annually reared and disposed of or the young bullocks are broken to work and supply any casualties amongst the ryot's own ploughing cattle It will be observed that the system of the northern talugs differs considerably from that of the south- [illegible] nd kept in the fand [illegible] ıvariably housed in [illegible] cultivation in the [illegible] the ryot to have a [illegible] ıd of the season, to [illegible] during the ensuing year. The stalk of the *sazza* crop is not used as provender for the cattle, as it is not nutritious, but is kept for thatching houses, cattle sheds, and the like, save in the wet villages

Trade in cattle.

Considerable herds of sheep and goats, particularly in the western taluqs, are kept. These flocks generally belong to the shepherds; but in many parts the ryots also own and rear a fair number. The wealthy and influential ryots of Nellore, Gudur and Kavali and the southern part of the Kandukur taluq are often extensive cattle dealers as well as breeders Gangs of men are despatched each year through the Kistna and Godavery districts, often far north of the latter district or inland to Dumagudiem on the Upper Godavery, and they purchase and bring down large numbers of small bullocks and buffaloes The buffaloes and part of the small cattle are sold in the wet [illegible] months, [illegible] atched [illegible] These [illegible] The

Nellore Cattle. (*H. T. Pease.*) | OXEN.

foregoing depicts the mode that has heretofore been pursued in pasturing cattle in Nellore; but the measures recently inaugurated, as regards the reservation of jungle tracts for wood, and the separate assignment to the ryots collectively of the equivalent of 30 per cent. of the area in occupation as common pasturage for the village, alter matters and curtail the privileges the ryots previously enjoyed, more particularly in the western taluqs, where there is a considerable margin beyond the 30 per cent., which, if not required to be reserved as wood, is now rented out in pasture farms. With the introduction of these measures the ryots, however, were relieved from the grazing or pullary tax, which was peculiar to this dis- [illegible] d renders it more easy [illegible] number of farms [illegible] formerly, the farms [illegible]

New rules regarding grazing lands.

G. I. C. P. O.—No. 103 R. & A.—26-10-93.—2,100.

THE

AGRICULTURAL LEDGER.

1895—No. 8.

INDIAN CULTIVATED COTTONS.

(GOSSYPIUM.)

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. IV., G. 381.*]

DESCRIPTIONS OF CERTAIN INDIAN BOTANICAL FORMS OF COTTON (GOSSYPIUM).

T. H. MIDDLETON, B. Sc.,
PROFESSOR OF AGRICULTURE, BARODA COLLEGE.

CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
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The objects of THE AGRICULTURAL LEDGER are —

(1) To provide information connected with agriculture or economic products in a form which will admit of its ready transfer to ledgers,

(2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,

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(4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these Ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it

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Considering the importance of the plant from a commercial standpoint, the effort that Government has made to improve the staple, and the interesting nature of the subject, from a botanical point of view, it is surprising that so little attention has been paid to the relationships that exist between the Indian members of the genus Gossypium. A considerable amount of discussion has taken place regarding the number of species of cotton found in the country, but since Roxburgh penned his descriptions of the cottons of Bengal, few fresh observations have been recorded in this country and no one (until Dr Watt took up the question a second time, some three years ago) has attempted a complete census of the forms of cotton cultivated in India.

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For four years I have cultivated cottons, obtained from correspondents in all parts of India, on the College Farm, Baroda, and I have thus become acquainted with a large number of forms, and have had opportunities of studying their behaviour in different seasons and on different soils The descriptive notes which I have put together here, at the request of Dr. Watt, will, I hope, be found accurate, they have in most cases been verified on many specimens of each form. For a thorough differentiation of the various races, the plants would have to be studied as field crops, and, except in the case of the Gujarat forms, I have not examined the Indian cottons in their native districts I have, therefore, had to attempt to discount the effects of a foreign soil and altered climate upon plants coming from other parts of India, but, I venture to think, that I have fairly successfully indicated all the more important distinctions between the different forms

The following remarks on the effects of soil and climate on the habit and structure of the cotton plant may assist readers in cases where discrepancies exist between my descriptions of the plants received from a particular district, and the actual characters of the plant as found growing in that district.

Habit —Soil affects the size and general appearance of the cotton plant to a very great extent On sandy loams and well-drained land most cottons are tall, lax in habit, with long, weak, spreading branches, on clay and badly drained soils they are small bushes with short branches

Hairs —These are not perceptibly affected in the first season by a change of soil and climate

Stems, Petioles & Peduncles are affected in size by a change in habit, but are not otherwise altered by a change of soil

Leaves, Stipules & Bracteoles are greatly affected in size, and the first and last to some extent in conformation, by change of climate These leafy organs are very different in a moist atmosphere from what they are in a dry, and herbarium specimens may be misleading if, *e.g*, some are made in the monsoon and others in the dry season The sinuate character of the leaf of the G. herbaceum series of cottons is only marked in the monsoon, and the extra lobe of the G arboreum series is more common and more marked during this season than it is afterwards. The bracteoles of the annual and shallow rooted cottons diminish markedly in size as the hot season advances

Flowers —These do not alter perceptibly in form or colour by transference to a new district If the plant is healthy the flowers will be normal, but like the bracteoles they diminish in size late in the season

Bolls —The bolls also become smaller especially on light soils, as the hot season advances, but those that form early in the season should be true to kind whether grown on clay or sandy soil

Seeds —In those bolls which mature well, the size or number of the seeds is not affected during the first season by a change of soil and climate

Lint —The fibre, more than anything else, is injuriously affected by change, but my remarks on the quality of the staple are of little practical value, in many cases I have omitted a notice of it altogether. The commercial value of the cotton produced by each district is well known, and as my object in growing the plants was not to classify the staples, but to ascertain the botanical characters of each form, the failure of the plants to produce good cotton is of less importance than at first sight it might seem to be

The cottons experimented with were generally grown on a sandy loam soil, freely drained The majority were also grown on a badly drained and heavier soil The seed was sown at various pèriods from the beginning of June until the beginning of August and the plants were allowed to occupy the ground until they died in the hot weather Many of the later forms that lived through the hot season were permitted to shoot again in the second monsoon

Cottons planted at the beginning of June were irrigated until rain fell With a few exceptions none of the varieties were irrigated at other seasons

The following table shows the rainfall at the College Farm for the monsoons of 1892, 1893, 1894, and 1895 —

Month		Rainfall			
		Year 1892	Year 1893	Year 1894	Year 1895
June	First fortnight	81	1 72	4 41	.58
	Second ditto . .	2 87	11 29	7 66	2 91
July	First ditto	5 26	11 44	13 99	·46
	Second ditto . .	3 68	3 32	13 88	13 43
August	First ditto	3 57	3 80	85	6 57
	Second ditto .	7 81	2 66	2 68	79
September	First ditto .	10 68	4 70	9 62	1 74
	Second ditto . .	2 70	1 71	3 23	37
October	First ditto . .		06		..
	Second ditto .	21	...	6 36	1 07
November	First ditto . .		...		.
	Second ditto .		63		..
		37 59	41 33	62 68	27 92

The following is a list of the cottons I have grown and examined, as also of the districts from which the seeds were obtained —

Name of Cotton		Districts from which seeds were obtained	Page
I Gujarat Cottons.	*Deshi* Cotton of Broach or *Kahnami Kapas.*	Broach, Etola, Mingam, Palej, Dabhoi, Kim, Nawsari	1
	Goghari Kapas.	Jambusar, Etola.	2
	Gundi Goghari Kapas	Etola	3
	Ambli Kapas	Ambli (Dhollera District)	*ib.*
	Sakalia Kapas	Dhollera District	*ib*
	Deshi Cotton of Kathiawar	Bhavnagar, Palitana, Amreli, Junagardh	*ib*
	Wild Cotton of Kathiawar	Palitana Rajkote	*ib.*
	Lalio Kapas	Bhavnagar, Palitana Dhola,	
	Kanvi or *Kanpui Kapas*	Botad Amreli Junagardh	4
	Wagria Kapas	Botad, Wadhwan, Dhrangadhra, Morvi, Viramgam	*ib*
	Mathia Kapas		
	Hybrids between *Mathia* and *Kanvi*	Bhavnagar.	
	Roji or *Jaia Kapas*	Baroda.*	5
II Dharwar Cottons (S Maratha)	*Coompta* Cotton	Dharwar.	7
	Saw ginned Cotton	Ditto.	*ib.*
III Madras Cottons.	*Tellapatti*	Bellary, Kurnool	*ib.*
	Uppam karungkanni, Cotton	Tinnevelly, Coimbatore	*ib.*
	Nadam Cotton	Coimbatore	8
	Yerrapatti	Kistna, Kurnool.	*ib*
	Karungkanni Cotton	Tinnevelly.	
VI Bengal Cottons.	*Desi* Cotton of Sarun	Chupra	9
	Disilla Cotton of Sarun	Sewan	*ib.*
	Jethayi Cotton	Gopalgunj	*ib.*
	Bhoglla Cotton	Sewan, Gopalgunj.	*ib.*
	Kapas	Burway and Taree, Lohardagga	
	Chandapara	Lohardagga	
	Bhoglla	Ditto	9
	Kherdya Kapas		10
	Nurdki		11
	Borea		*ib*
	Burdya.		*ib*
	Malgacha (G hirsutum).		
	Narma (American Cotton)	Gopalgunj and Sewan, Sarun	
V. Cottons of Central Provinces, Berar and Khandesh.	*Bani*	Central Provinces, (grown at Nagpore Farm)	12
	Jari	Ditto (ditto)	*ib*
	Nimari	Central Provinces Nimar District, (grown at Nagpore Farm)	13

* I have examined this cotton in many districts, it grows everywhere in the country lying between Baroda and Ahmedabad.

In the matter of nomenclature, I have followed the classification of Todaro as explained in the Dictionary of Economic Products I have, however, used the old name G. herbaceum for the plant which he isolates as G. Wightianum, as I am unable to accept the distinction which he makes between these species. From my own experience in growing Indian cottons, I think that Todaro has named far more species of Gossipium than actually exist The only species

GUJARAT COTTONS.

¾-inch to 1 inch in length; seed-cotton generally yields 33—35 per cent. clean cotton.

Habitat and Season.—This cotton is cultivated in Nawsari, Surat, Broach, and part of the Baroda districts and in the Rajpipla State. It grows on black clay soil; is sown in June, just before, or just after, the begin- [illegible] er and to [illegible] onths. In [illegible] the end of [illegible] acre. The [illegible] s rank first [illegible] *Goghari*,

Yield.

which occurs in a few districts, *Kahnami* cotton is pure. *Roji* plants occasionally find their way into the fields, but they are easily distinguished; and the cultivators remove them, even if left they do no harm, for *Roji* produces very few bolls in the first year and these not until after *Kahnami* cotton has been picked. I have never seen cottons of the G neglectum [illegible]

[illegible] roach produce the best, and the worst, forms of *Kahnami* cotton. The difference in quality depends mainly upon the soil.

(2) ***Goghari Cotton*** is a distinct race of the *Kahnami* cotton, grown on both sides of the *Dhádar* river between Baroda and Broach, and also to [illegible] *Kahnami*, [illegible] junction of [illegible] til the bolls [illegible] ral points of difference:—

(1) The whole plant is more robust than the ordinary Broach cotton; this is chiefly because the soil on which *Goghari* is grown, is better drained than the clay soils which yield *Kahnami*; when the two plants are grown together they are similar in habit.

(2) The bolls are globose and larger than those of *Kahnami*. The segments of the capsule are very broad and usually do not recurve when the fruit is ripe.

(3) The seeds are larger than those of *Kahnami*, are darker in colour and have more fuzz.

(4) The wool adheres more firmly to the seeds, is whiter, crisper, coarser, and more abundant. The wool surrounding each seed separates readily from the wool of the others and does not 'cling' as in *Kahnami*. The percentage of clean to seed-cotton is high, usually 36—38 and in some samples 40 per cent.

Origin.—When I first met with *Gogh* [illegible] a cross between *Kahnami* and *Roji* (the [illegible] on loam soils at the junction of blac [illegible] assumed the tall habit of *Roji*, and—tho [illegible] the value of *Kahnami*—the staple was [illegible]

GUJARAT COTTONS.

which the Broach ryots found peculiarly adapted to certain soils The *Goghari* plant shows no trace of **G. arboreum** descent and *Kahnami*, that, except for the globe I should have thought it *Deshi* ancestor Since its for at least 20 years), G suits a soil on which *Kahnami* is much the more , unless care had been tak separate, *Goghari* would soon have been lost A considerable number of cultivators regularly select their *Goghari* seed, but the majority content themselves with getting it from the money-lenders, and since the introduction of steam gins, seed so obtained has been very impure

Fields of pure *Goghari* exist in some villages, but they are comparatively rare, and all the crops I have seen have been mixed *Goghari* and *Kahnami* seem to cross readily Plants intermediate between the two types are very common

(3) ***Gundi Goghari***.—A cotton known as *Gundi Goghari* is occasionally met with near Baroda This plant has smaller and more numerous bolls than *Goghari* proper, and the cotton is believe it to be merely an interm

(4) ***Lalio Cott*** . soils in the Ahmedabad dis evelopes into a tall pyramida sinuate leaf-lobes than the type * In respects the plants are the same, and it is doubtful whether *Lalio* is even a variety of *Kahnami*.

The name *Lalio* is, in Kathiawar hangs down (saliva-like) when of which remain closed, so that and the Ahmedabad district th same tall form is grown in the *Deshi* "

The most which differ mo known to mercha growing on the Kathiawar coast nea Dhollera.

Ambli was described by the merchant who sent me the seed as a high class Dhollera colour, staple and outturn good Broach *Sakalia* is on account of the h

(5) ***Deshi or A***

the variety most fre Bhavnagar, Palitan. fine silky staple, little

and the *Deshi* of Broach are exceedingly slight When grown under the same conditions the former is a smaller plant, with the narrower leaf lobes and fewer hairs of *Ambli*, it is in fact a connecting link between ordinary Broach and the Dhollera *Lalio* It has the habit of the former and the foliage of the latter. In these three forms the bolls, wool and seeds are alike as regards shape, silkiness and size, but the commercial value of the staple varies from place to place under the slightly different conditions of soil, climate, and cultivation

(* The behaviour of cotton is an example of a general rule Tap rooted plants run far more to stem and leaf on light soils than on clay *Tur* (Cajanus indicus) is another familiar illustration of this fact)

GOSSYPIUM. Descriptions of the

GUJARAT COTTONS

(6) **Kanvi or Kanpuri** cotton is grown all over Southern Kathiawar and, as just noted, it is rapidly ousting the *Deshi*

This form is said to have come from the north of India within the last ten or fifteen years: hence the name *Kanpuri*. In general appearance it closely resembles the *Deshi*, it differs (1) in being more robust, (2) in having the lobes of the leaves broader and less sinuate than in Kathiawar *Deshi* and similar to the leaf-lobes of *Wagria*, (3) the bolls are frequently 4-celled and are globose.

Description.—The bolls, wool and seeds of *Kanpuri* closely resemble those of *Goghari* the only difference being that the bolls of the former are smaller and smoother than those of the latter *Kanpuri* is to Kathiawar *Deshi* what *Goghari* is to Broach *Deshi*. Commercially it is less valuable than *Goghari*, because the conditions under which cotton is cultivated in Kathiawar are inferior to those of Broach.

[illegible]

plant for traces of its connection with the cottons of this family, but, excepting the larger seeds and coarser wool (which are not necessarily evidence of affinity), the only thing I have noticed is that the middle and two side ribs of the leaf of *Kanpuri* are more frequently furnished with glands than in Broach *Deshi* The cottons of the G arboreum group generally have the three ribs [illegible] on more than one r[illegible] North-West are [illegible] which *Kanpuri* differs [illegible] of what might b[illegible] leaved cottons [illegible] the bolls of the former are short ovate, with a very short obtuse point ending in a bristle. The only cotton I know of in Northern India, which at all resembles *Kanpuri*, is a variety described as Bengal *Desi* (No 15) This cotton, like our Gujarat annuals, belongs to the G herbaceum series, and this or some similar G herbaceum cotton of the north may possibly, but I think improbably, have given rise to the *Kanpuri* of Kathiawar

Mathia Cotton.—The narrow-leaved and white-flowered cotton, which is [illegible] has found favour with the cultivators [illegible]

[illegible] war. The name seems to indicate [illegible] district lying to the north of the Runn of Cutch The most typical forms of *Wagria* are found in the north of Kathiawar, on the south shore of the Runn; southwards its character changes and it becomes very similar to the *Kanpuri* variety.

[illegible]

3—5-lobed, cordate, half segmented or less; lobes ovate to broad ovate, con-

GUJARAT COTTONS

stricted at the base, the lobes of the leaves on the younger branches are broad, obtuse, and not constricted at the base *Stipules* ½ inch linear acuminate, those on peduncles unequal as in *Deshi* *Bracteoles* less than half the length of the corolla broadly ovate, cordate dentate or sub

hs, spreading as the es is seen in all the *Wagria*, where they *Flower* as in *Deshi*, smooth globose, mostly y are forced open by hand after harvesting the cotton, wool white, coarser than Broach, seeds medium, size 5—8 in cell covered with yellow to brown velvet

Habitat and Seasons — The plant requires less moisture than the varieties described above It takes eight months to ripen I have grown *Wagria* cotton for three seasons and have obtained seed from five districts in Kathiawar The characters above given are those of the more northerly growths Seed from Botad, which is on the borders of the *Kanvi* growing district, produced *Wagria* cotton that much resembled *Kanvi*

Broach *Deshi* than any of the varieties yet described I consider *Wagria* like the more hirsute *Kahnami* to be descended from a G herbaceum ancestor, and that present differences are due to the different climates in which the plants have been cultivated

I further think that the crossing of *Wagria* with *Deshi* has produced the round bolled, and coarser fibred varieties known as *Kanpuri* and *Goghari* The segments of the boll are much alike in all three cottons

ing and (except

(8) *Roji or Jaria Cotton.*—This is a perennial, cultivated upon light soils in northern Gujarat

character, are very distinct *Stem* woody beneath and cinereous or with a brownish tinge, young parts herbaceous green and red where exposed to the sun *Leaves* cordate, mostly 5 lobed, half segmented, lobes ovate acute to acuminate, narrower than the lobes of the leaf of *Kahnami* somewhat constricted at the base, large extra lobe frequent in the sinus on either side of the middle lobe, margins not sinuate, leathery dark green in colour, glands usually on three ribs *Petioles* about as long as the leaf blades thickened at the base Stipules small ⅛ inch to ¾ inch falcate

rne on secondary or tertiary 3 on each branch *Peduncles* toothed, sometimes entire, ovate acute, half as long as corolla at base truncate or subcrenulate pfe centre, rapidly turning pink on mostly 3 celled, trigonous in cross section, ovate acuminate, opening fully when ripe *Seeds*, 5—7 in each

GUJARAT COTTONS

cell, covered with greenish-grav fuzz, wool adhering firmly, white; staple poor, short, and harsh

Habitat and Season —This cotton is cultivated as a mixed crop, one row being sown between ten or twelve rows of some cereal In the first season it yields little or no cotton, in the hot weather it is cut down to within ... it grows luxuriantly and ... The cotton of subsequent ... nd, and the plant is usually rooted out at the end of the third or fourth season but it is occasionally allowed to grow for six or seven years When growing wild in hedge rows the cotton turns yellow, and very short in the staple the fuzz at the ...

taken for a cross It strongly resembles G arboreum, the chief difference being a yellow flower and the absence of the marked reddish tinge possessed by this species

Roji would appear to have become possessed of a yellow flower within the past two years, for when Hove was in Gujarat the perennial cotton which he found being cultivated in precisely the same way in which *Roji* is cultivated now, had a red flower Some of our best Gujarat cultivators are said to have come from the north of India in the 17th century, and it is possible that Hove's red-flowered cotton may have been brought from the north by them, a red flowere ... vated in the Punjab at the prese ... wild cotton found by Dr Watt in ... from Marwar* to the Poona Farm where it was cultivated as G Wightianum, *Tod*, which it is not

* [The admitted similarity of these wild plants surely points to their being a distinct species but see foot note, page 17. Editor]

Concluding Remarks on Gujarat Cottons

The above are all the varieties of indigenous cottons I have found cultivated in Gujarat

In the local Gazetteers a number of names are given, and these are quoted at pages 63 and 64 of Vol IV of the Dictionary of Economic Products Some of these names I have not heard used, but I believe that all refer to one or other of the nine varieties described here, or to a foreign cotton

The Editor of the Dictionary quoting the Broach *Gazetteer* mentions *Lalio, Jaria, Roji,* and *Narma* I have not heard the name '*Lalio*' used by Broach cultivators *Lalio* cotton is always called *Deshi* or *Kahanam* in this district The name '*Lalio*' is used in Ahmedabad and Kathiawar *Jaria* and *Roji* are the same *Narma* is of several kinds G barbadense is the most common; *Kidney* cotton G. brasiliense, and true *Narma*, G. arboreum, are comparatively rare

Viramgam is said to grow *Jaleari* this is a name I do not know, Viramgam does grow *Wagria* and *Lali*

Bhalia cotton simply means the ... f the Bhal cou... d s... trict at the head of the Gulf of Cam... as includes the ... ve ... been already ... to ... an to no one pro... ion, ... fully, as distir... from ... nd ... *And Deshi* ... ar ... also ... or *Kanpas* and ... I m ... e l ext ... the sin... he ...

II.—COTTONS OF THE SOUTHERN MARATHA COUNTRY.

SOUTHERN MARATHA COTTONS.

(9) *Coompta Cotton.*—This cotton did not develop well in Baroda' the plants were low-branched bushes, 12 inches to 18 inches high and closely resembled small plants of Broach *Deshi*. The seed was pure and all the cotton was of one variety.

Description.—Stems, petioles, &c., very hairy; stem herbaceous,

peduncles unequal. *Petioles* ½ the length of the leaf-blades. *Peduncles* very short. Bracteoles small, dentate, or inciso-dentate, ovate. *Calyx* crenulate. *Corolla* twice as long as bracteoles, opening fully, yellow with deep-red patch at the base. *Capsules* small, 3-celled, ovate. Seeds with yellowish-gray velvet.

grew at the farm were weak and puny, but showed no trace whatever of hybridisation with G. herbaceum.

III.—MADRAS COTTONS.

(11) *Tellapatti.*—Seed of this variety was received from Bellary and Kurnool. The seed appeared to be mixed, some being covered with a short gray fuzz and others being naked like the seeds of Bourbon cotton.

following description stands for both.

Description.—Low-branched bushes, much resembling small plants of Broach *Deshi*, stem, branches, petioles, leaf-ribs and peduncles villous. Young leaves covered with branched and stellate hairs, older leaves moderately hairy. *Stem* herbaceous, green. *Leaves* cordate, 3—5-lobed, palmatifid;

together at the ends of secondary branches. *Boll* small, 3—4 celled, acute to acuminate. *Seeds*, 6—8 in cell, small rounded or ovate, almost or quite free from velvet.

Origin.—Tellap

and there can be n

Apart from the s

to growth under unsuitable conditions) the most noticeable distinctions between Broach and Bellary cottons are, (1) the occasional naked seeds of the latter, and (2) that the older stems of *Tellapatti* are much more thickly

MADRAS COTTONS.

The seed of *Uppam* was mixed to a small extent with seeds of the *Nadam* variety.

... e a poor and degenerate ... with those of *Nadam*

... dark-green foliage and deep-red stem and branches. In the bud and on the ribs and mesophyll of the youngest leaves there are numerous small neat stellate hairs, these fall off quickly, full-grown leaves have few hairs and old leaves are glabrous. *Glands* and glandular dots well marked all over the plant. *Stem* strong, erect, branches numerous ascending *Leaves*, slightly to distinctly cordate, 5 lobed, palmatifid; lobes ovate-acuminate to ovate pointed; margins not waved; sinus not bent up in a fold; extra lobe pretty common, blade as long as broad Young *leaves* ...

... ary and tertiary branches *Bracteoles* separate almost to the base, small, ovate to triangular entire or toothed, enlarging slightly in the fruit, much like those of *Roji* *Calyx* moderately large, truncate to crenulate, glands at the base marked. *Corolla* medium size, more than twice the length of the bracteoles, bright yellow with a purple patch at the base, pink on outside in bud and rapidly turning pink on passing maturity. *Stigma* eglandular, consists of 3—4 bands, often much twisted, usually projects about half an inch beyond the staminal tube. *Capsule*, 3—4-celled, elongate ovate with a short point. Seeds 6 to 7 in cell, medium size, thick, fuzz gray; wool white, short, firmly adhering to the seed.

Origin.—In habit, in the nearly glabrous character and in the colour of ...

... common stock. *Nadam*, like *Roji*, is a perennial, it flowers and begins to ...

... enlarging greatly in fruit ... *Flowers* yellow with purple ... size, 3—4-celled, triangular acuminate. *Seeds* small greenish, fuzz, ovate; wool short in staple, silky with a reddish tinge

Origin.—*Verrapatti* differs from *Nadam*, its nearest Madras relative as follows:—

(1) The stems and branches are not markedly red.

(2) The foliage is paler green.

BENGAL COTTONS

(3) Stellate hairs are more numerous both on the young and the old leaves.

(4) The bracteoles enlarge much more in the fruit

(5) Calyx very shallow and cup shaped

(6) Bolls are long triangular, acuminate

(7) Seeds are smaller and covered with a greenish fuzz

(8) Cotton has a reddish tinge

IV.—BENGAL COTTONS

(15) *Desi* from Chupra, Sarun.

Description —A robust pyramidal bush standing 3—6 feet high, stem erect, much branched; branches ascending, woody below, younger parts and petioles, leaf-ribs, &c, villous, but less hairy than in Broach cotton; reddish below; young parts green *Leaves* when young thickly felted with delicate branched stellate hairs, full grown leaves less hairy than in Broach, and old leaves almost glabrous, dark green in colour and leathery in texture, base cordate, palmatifid, sometimes almost palmatipartite, 5—7-lobed, lobes ovate (narrower than in Broach) acuminate or acute, constricted at the base, sinus rounded, with rarely an extra lobe, midrib glandular (side ribs very occasionally have glands) *Petioles* vary, usually, a little shorter than leaf-blades *Stipules* linear acuminate, falcate when drying *Flowers* borne on secondary or tertiary branches, several on each branch *Peduncles* short *Bracteoles* medium to large, deeply cordate, broad ovate, laciniate, ears large, not enlarging much in fruit (The bracteoles are like those figured in Todaro's Monograph as those of G herbaceum) *Calyx* crenulate frequently with two teeth *Corolla* twice as long as bracteoles or less pale yellow with red patches at the base *Stigma* 3 flat united bands, with double rows of black glandular dots between each *Capsule* elliptical to globose with a short point, small, 3—4 celled cells 3—5-seeded *Seeds* small with a very short, or with no beak on the hilum, fuzz thick white on surface, greenish underneath, wool short, weak and scanty

Origin —This *Desi* cotton of Sarun is closely allied to the family to which the Gujarat annual cottons belong It differs from Broach mainly in the following points —

(1) The stem and branches are stronger, so that the bush is more regularly pyramidal

(2) The leaves are dark green and less hairy

(3) The bracteoles are larger, thinner and more deeply gashed

(4) The bolls are smaller and have fewer seeds in each cell

(5) The beak on the hilum is much reduced

Desi cotton resembles closely the G herbaceum *var* microcarpum of Todaro, but the extra lobe in the leaf and the narrow leaf-lobe which is marked in some specimens point to a trace of G aboreum in its ancestry

Disilla cotton seed sent to me from Sewan, Sarun and *Jethayi* from Gopalgunj, Sarun, produced plants identical with the above

(16) ***Bhoglla or Bhogola Cotton.***—Four samples of seed bearing this name were sent to me, two of these produced the white-flowered cotton described as *Nurdhi* (No. 20) the other two from Sewan and Gopalgunj in the Sarun district produced the plant described below.

Description —Pyramidal bushes resembling in general appearance the *Desi* of Chupra. Stem red, young parts less hairy than in last; simple hairs on petioles, ribs, &c, youngest leaves covered with stellate hairs

BENGAL COTTONS.

cells 6—8-seeded Seeds very small, short beak on hilum, fuzz dark-gray, wool white, firmly adhering to seed, scanty, poor staple.

Origin—*Bhoglla* cotton seems to hybridise with *Desi*, for several doubtful and intermediate forms grew among the *Bhogalla* plants, the seed, ... *gunj*

(... *Bhoglla* variety, the bases of the lobes are scarcely at all constricted and three ribs are usually glandular

(2) The bracteoles are coarser than in *Desi*, are more triangular and are entire or sub entire.

(3) The peduncles are extra-axillary.

(4) The flowers are larger.

(5) The calyx is toothed.

(6) The bolls are ovate, pointed, not globose as in *Desi*.

(7) There are 6—8 seeds in a cell, not 3—5 as in *Desi*

Bhoglla cotton presents many points of resemblance to the *Roji* of Gujarat and the *Nadam* of Madras, and is the Bengal representative of the cross aboreum herbaceum cottons

(17) *Kherdiya*,—From Lohardagga* under the name of *Kapas*, and from another district under the name of *Kherdya* I received the seed of ... cotton described below.

... to 2 feet high, ... each cotton and ... number of hairs. ...-7-lobed; lobes ... times an extra lobe; margins ...

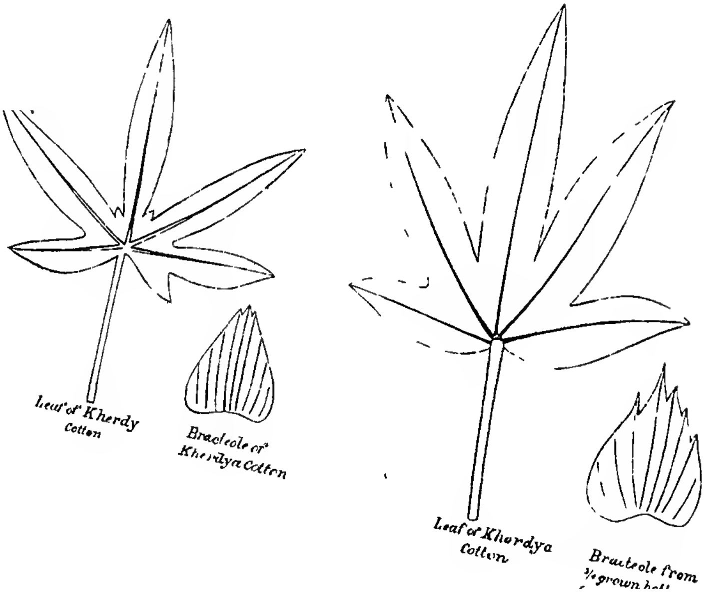
large, broad and unequal ...

Bracteoles sub-entire, mor... almost to base, narrow triangular, acute, not enlarging much in fruit. *Calyx* toothed, with marked glands at base *Corolla* medium size, yellow with deep-purple patch at base, rapidly turning pink on withering. *Boll* long pointed, ovate acuminate, 3—4-celled. *Seeds* small; beak very short, fuzz brownish or greenish

... forwarded ... Cotton seeds from ... h a yellow flower ... kinds were occa... ...ple, (3) *Bhoglla* ... must have been ... The red flowered ... other varieties are

G. 381.

II. G. neglectum   Common Types of Leaves and Bracteoles



BENGAL COTTONS

Origin —This cotton is different from any of those hitherto described It is Todaro's G. neglectum

Forming connecting links between *Kherdya* and *Desi*, there are two Bengal cottons which came to me with the names *Bores* and *Burdya*

(18) *Boren* cotton is very similar to the last, it differs from it as follows —

(1) The whole plant is larger and more robust
(2) The bracteoles are broadly ovate, toothed and nearly as long as the bolls, in *Kherdya* they are narrow, triangular, and half as long as the bolls
(3) The bolls are much shorter than those of *Kherdya*

The cotton produced by this plant was said by the sender of the seed to be of very good quality.

(19) *Burdya* cotton is a step nearer *Desi* than the last, but is still "neglectum" in most of its characters. It differs from *Kherdya*—

(1) in being larger and more robust,
(2) in having the lobes of the leaves broader

The cotton produced by this plant was said to be of moderate quality

(20) *Nurdki* —This cotton was sent to me from Lohardagga under the name of *Bhogla* and from the office of the Director of Agriculture, Bengal, with *Bhoglia* written in English on the parcel, and *Nurdki* written in Bengali inside the parcel. As an entirely different plant was sent to me from Sarun under the name of *Bhoglia*, I adopt the name *Nurdki* for the white flowered species described here

Description —Small erect plants with palmatipartite leaves and white flowers *Stems* brown and woody sparsely covered with simple hairs Young parts covered with numerous minute stellate and simple hairs, old leaves with a few stellate hairs on both surfaces, and some simple hairs on the ribs petioles, &c *Leaves* cordate palmatipartite to palmatisect, 5—7 lobed lobes linear, lanceolate, acute sinus broad, extra lobe rare margins never sinuate *Petioles* shorter than leaf blade. *Stipules* small *Flowers* on secondary branches, *peduncles* short *Bracteoles* entire or sometimes dentate, narrow, ovate half length of corolla enlarging somewhat in the fruit. *Calyx* large accrescent forming a wide shallow cup when the corolla fades, crenulate or sub dentate nearly white covered with black dots, glands at base large *Corolla* small about 1½ inches across, convolute, pale yellow white in the bud whitish when open, but very quickly fades pink, purple patches at base *Stigmas* eglandular *Capsule* ovate acuminate, or ovate acute, about 1¼ inches long 3 celled *Seeds*, 5—6 in cell, medium to large, ovate with a beak but not the long point of *Kahl Belati*, fuzz greenish brown, wool scanty, finer than in *Varadi* but not so white, staple poor

Origin —Except for the colour of the flower *Nurdki* closely resembles *Kherdya*, and it is possibly a cross between G neglectum and G roseum.

Malgacha —Under this name the seed of what was termed a "very good" cotton was sent to me from Bengal It proved to be G hirsutum, or as it is usually called in India, "Upland Georgian Cotton" This and several other acclimatised 'Americans' have been grown in small plots at the College Farm, and have done very much better than any of the freshly imported varieties which were planted beside them Seed got from America produced puny plants not worthy of the name 'bush', from the acclimatised seed on the other hand, we raised strong and vigorous plants This is an instance of the way in which cotton may alter its character under new conditions Few plants suffer more at first from a change of climate, but, given time, it will alter its habits and adapt itself

CENTRAL PROVINCES' COTTONS.

to new circumstances. Unfortunately for India one of the first variations which exotic cottons undergo when brought to the country, is a change (and always for the worse) in the staple.

V.—COTTONS OF THE CENTRAL PROVINCES, BERAR, AND KHANDESH.

(21) ***Nagpore Cotton, Variety A.***—Seed of this plant was sent to me from the Nagpore Farm, from Khandwa and from Khangaum.

Description.—Erect little-branched bushes, standing from 2½ to 4 feet high; young parts hairy; old, nearly glabrous; ribs, etc., furnished with simple, the leaves with small, stellate hairs. *Leaves* slightly cordate, palmatifid 3—7, mostly 3-lobed; lobes ovate acute, slightly constricted at

sub-dentate, not enlarging much in fruit *Corolla* twice the length of the bracteoles, large, petals markedly oblique, yellow with a deep-purple patch at the base. *Stigmas* cleft *Capsules,* 3—5-celled, frequently 4-celled, long ovate acuminate, about 1¾ inches long. *Seeds,* 7—8 in cell,
ynish gray; cotton white and silky,
ariety B.—A second and very similar
A. It differs as follows:—

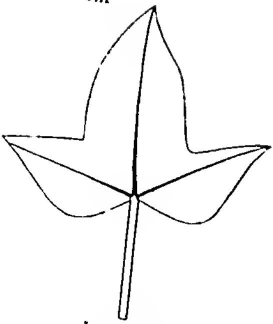
(1) It matures later.
(2) The midrib of the leaf is eglandular.
(3) The bracteoles are larger, *more* delicate and *usually dentate.*
(4) The flowers are very large, 3 inches—3½ inches across.
(5) The bolls are ovate and abruptly acuminate; whereas the bolls in the last variety are conical and pointed.

I have only met
pore Farm seed,
Khangaum in the
The merchant
tricts wrote of
cotton that is gr it possesses a good staple, is silky, and commands a high price; but the outturn of ginned cotton as compared to seed is small, and, as the price does not make up
out of cultivation." Of
(a word which, I believe,
d *colour; but the outturn*

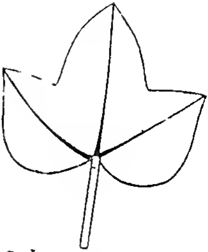
first contained a few, and the s
d plants described below.

ow grown in
hat formerly
variety was
representa-
tive of what was once an important cultivated race in Central and probably in Northern India and that it is the plant Todaro refers to as G. Indicum Lamk, *vide* Dictionary of Economic Products, Vol. IV, p. 29. The "A" variety is probably the *result of a* cross between the species G. Indicum and G. arboreum. A degenerate form of this cross, mixed with the cotton next described, is the growth now known as *Jari* in the Central Provinces.

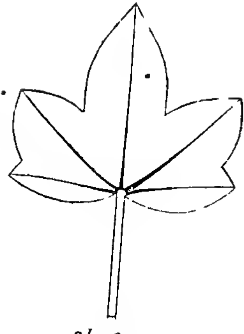
III. G. indicum



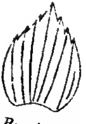
a Leaf of Bani Cotton



a Leaf of Bani Cotton



a Leaf of
Nagpore farm B (Bani) Cotton



Bracteole
from open flower of
Bani Cotton

PANJAB COTTONS

White-flowered cotton is a dangerous rival to finer varieties By nature it is made to supplant When brought to a new district, instead of pining as most exiled cottons do, it develops all its best properties, grows robust, matures early, is prolific and so wins the favour of the cultivators, once established, it begins to degenerate joins company with the worst of the native varieties and forms the mixed growths ngals of commerce
and the *Katil Belati* of Akote are
cotton is when it appears in a new district, *Varadi* is a form on the decline, and *Nurdki* appears to have fallen low even among Bengals *

VI.—PANJAB COTTONS

Through the Director of Agriculture, I obtained six varieties from this Province Three of these were from Shahpur district two from Amballa, and one from Rawalpindi

Of the Amballa cottons one had yellow floss, the seeds were those of an American cotton, but as they refused to germinate I could not determine the species The o
described as *Nurdki*
cottons like those of

(24) ***Rawalpindi Cotton.***—Low branched bushes

large *Bolls*, 3—4 celled,

beak on hilum short, covered with a brownish fuzz, staple short and poor

Origin —This variety seems to be more nearly related to *Bani* than to any other cultivated cotton

*(25) ***Narma***—The first parcel of *Narma* seed received from the Panjab in 1892 was very impure and most of the plants grown from it bore yellow and white flowers, in 1894 I got a fresh supply of fairly pure seed from which the plants described below were raised

Description —*Pyramidal little branched bushes, stems, petioles peduncles*, bracteole and veins of leaves of a reddish purple colour, stems and petioles with short simple hairs, youngest leaves pubescent, hairs stellate, old leaves almost glabrous *Leaves* slightly cordate, palmatipartite or palmatifid, 5-lobed, lobes ovate acuminate mucronate, middle lobes con
of grown leaves does not rise in
drib eglandular *Stipules*
owers two to three on short
as bracteoles *Bracteoles*

* With the cottons from the Shahpur district the following notes were sent by the Deputy Commissioner —

"1 *Narma Cotton* —Red flower, small seed and pod cleaned cotton softer than other varieties in the country

"2 *Bagar Cotton, also known as Walni Cotton* —Seed small of whitish colour, yellow flower, cleaned cotton not very soft, commonly cultivated in the Shahpur district

"3 *Bajwara Cotton* —Seed rather large and of a greenish colour, red flower, cleaned cotton soft, produces less cleaned cotton than any other varieties

PUNJAB COTTONS.

ovate acute, entire, or slightly dentate, deeply cordate, separate to the base of the ears, ears large *Calyx* reddish, crenulate; glands at base. *Corolla* pink with deep-purple patch at base, or deep red in colour, small, opening fully 1½ inches across, slightly longer than the bracteoles *Stigma* 3-fid, eglandular, but with brown lines between the stigmatic bands. *Capsules* small, 3—4-celled, ovate acuminate, as long as, or sometimes shorter than the bracteoles which enlarge considerably in the fruit. *Seeds*, 8—9 in cell, small rounded; beak on hilum very short; fuzz brown; staple very short but silky

Origin.—The purple tint of the petioles, veins, bracteoles and bolls as well as the red flower, makes *Narma* easily distinguished from any other cultivated cotton. In its colouring it closely resembles G arboreum, and it is probably a hybrid between this species and G. Indicum.

Bajwara.—Of the *Bajwara* variety I grew specimens in 1892 and again in 1894. The former were identical, or almost identical, with *Narma*, the only difference I noticed was that the bracteoles were smaller, and that the corolla was more uniformly red; like *Narma* the *Bajwara* cotton of 1892 was mixed with yellow flowered plants. The sample of *Bajwara* seed sent me in 1894 produced G. hirsutum, like the *Malcacha* of Bengal, and I think that it is to G. hirsutum that the name must be applied in the Panjab The Deputy Commissioner of Shahpur described the flower as red and the seeds as large and green, this description of the seed corresponds with the seed of the American variety, not with that of the other, and though the flower of G. hirsutum is pale yellow when open, it quickly turns a reddish pink when past maturity

(26) ***Bagar or Walnut Cotton.***—A mixed crop grew from the seed sent under this name. The predominant plant was the yellow-flowered variety described above as Rawalpindi cotton With it were (*a*) a plant with yellow flowers and palmatipartite leaves, like the *Kherdya* of Bengal, (*b*) a few plants of *Narma*, and (*c*) a variety with white flowers and palmatifid leaves which is described below.

Description.—Plants small, erect, stems little branched, hairs stellate, very small and few except on buds. *Leaves* palmatifid, mostly 5-lobed, lobes ovate acute, constricted at the base *Stipules* on the peduncles very small, *Bracteoles* small, ovate acute or acuminate *Corolla* white, small, 1½ inches across, nearly twice as long as bracteoles *Capsules* ovate pointed

Origin.—This cotton is distinguished from the other white-flowered varieties by having palmatifid, not palmatipartite, leaves, and by the small bracteoles

Except in the colour of the flowers the three Panjab cottons,—the white-flowered, the red-flowered *Narma*, and the yellow-flowered Rawalpindi—are much alike, the red-flowered plant is a tolerably pure member of the arboreum group and the white and yellow flowered races are possibly crosses with G. roseum and G. indicum, respectively

VII.—COTTONS OF THE NORTH-WEST PROVINCES

I received two samples of cotton-seed from the North-West The first from the Saharunpore gardens was labelled "Country cotton." It proved to be a mixture of four varieties already described. The majority of the plants had yellow flowers and palmatifid leaves like Rawalpindi cotton, but were more robust in habit, the others had yellow flowers with palmatipartite leaves, white flowers with palmatifid leaves and white flowers with palmatipartite leaves. The other cotton came from the Cawnpore Farm, it was a variety of Todaro's G. neglectum free from admixture.

PANJAB COTTONS

White-flowered cotton is a dangerous rival to finer varieties By nature it is made to supplant When brought to a new district, instead of pining as most exiled cottons do, it develops all its best properties, grows robust, matures early, is prolific and so wins the favour of the cultivators; once established, it begins to degenerate, joins company with the worst of the native varieties and forms the mixed growths that constitute the bulk of the 'Bengals' of commerce

The *Mathia* of Bhavnagar* and the *Katil Belati-ol* Akote are examples of what white-flowered cotton is when it appears in a new district, *Varadi* is a form on the decline, and *Nurdki* appears to have fallen low even among Bengals'

VI.—PANJAB COTTONS

Through the Director of Agriculture, I obtained six varieties from this Province Three of these were from Shahpur district two from Amballa, and one from Rawalpindi

Of the Amballa cottons one had yellow floss, the seeds were those of an American cotton, but as they refused to germinate I could not determine the species The o [illegible] described as *Nurdki* [illegible] cottons like those of [illegible]

(24) ***Rawalpindi Cotton.***—Low branched bushes, [illegible]

[illegible] triangular, entire acute *Corolla* twice as long as bracteoles, moderately large *Bolls*, 3–4 celled, acuminate *Seeds*, medium size, flattened ovate, beak on hilum short, covered with a brownish fuzz; staple short and poor

Origin—This variety seems to be more nearly related to *Bani* than to any other cultivated cotton

*(25) ***Narma***—The first parcel of *Narma* seed received from the Panjab in 1892 was very impure, and most of the plants grown from it bore [illegible] in 1894 I got a fresh supply of fairly pure seed

[illegible], stems, petioles, peduncles [illegible] purple colour, *stems and* petioles with *short simple hairs*, *youngest leaves pubescent*, hairs stellate, old leaves almost glabrous *Leaves* slightly cordate, palmatipartite or palmatifid, 5-lobed, lobes ovate acuminate mucronate, middle lobes constricted at base, margins not waved, sinus of grown leaves does not rise in a fold, but frequently has an extra lobe, midrib eglandular. *Stipules* linear, falcate, those on peduncles unequal *Flowers* two to three on short lateral branches *Peduncles* very short as long as bracteoles *Bracteoles*

* With the cottons from the Shahpur district the following notes were sent by the Deputy Commissioner —

"1 *Narma Cotton*—Red flower, small seed and pod, cleaned cotton softer than other varieties in the country

"2 *Bagar Cotton*, [illegible]

"3 *Bajwara Cotton*—Seed rather large and of a greenish colour, red flower, cleaned cotton soft, produces less cleaned cotton than any other varieties

PUNJAB COTTONS

ovate acute, entire, or slightly dentate deeply cordate, separate to the base of the ears, very large. *Calyx* red lobed, crenulate; glands at base. *Corolla* pink with deep purple patch at base, or deep red in colour, small opening to 1½ inches across, slightly longer than the bracteoles. *Stigma* 3 fid, eglandular, but with brown lines between the stigmatic bands. *Capsules* small 3—4 celled ovate acuminate, as long as, or sometimes shorter than the bracteoles which enlarge considerably in the fruit. *Seeds*, 8—9 in cell small rounded; beak on bottom very short; fuzz brown; staple very short but silky.

Origin.—The purple tint of the petioles, veins, bracteoles and bolls as well as the red flower makes *Narma* easily distinguished from any other cultivated cotton. In its colouring it closely resembles G arboreum, and it is probably a hybrid between this species and G. indicum.

Bajwara.—Of the *Bajwara* variety I grew specimens in 1892 and again in 1893. The former were identical or almost identical with *Narma*, the only difference I noticed was that the bracteoles were smaller, and that the corolla was more uniformly red; like *Narma* the *Bajwara* cotton of 1892 was mixed with yellow flowered plants. The sample of *Bajwara* seed sent me in 1893 produced G. hirsutum, like the *Halgachi* of Bengal, and I think that it is to G. hirsutum that the name must be applied in the Panjab. The Deputy Commissioner of Shahpur described the flower as red and the seeds as large and green, this description of the seed corresponds with the seed of the American variety, not with that of the other, and though the flower of G. hirsutum is pale yellow when open it quickly turns a reddish pink when past maturity.

(2 c) *Hazara or Hatal Cotton*.—A mixed crop grew from the seed sent under this name. The predominant plant was the yellow flowered variety described above as Rawalpindi cotton. With it were (a) a plant with yellow flowers and palmatipartite leaves like the *Khersa* of Bengal (b) a few plants of *Narma* and (c) a variety with white flowers and palmatifid leaves which is described below.

Description.—Plants small, erect; stems little branched; hairs stellate very small and few except on buds. *Leaves* palmatifid mostly 5 lobed, lobes ovate acute, constricted at the base. *Stipules* on the peduncles very small. *Bracteoles* small, ovate acute or acuminate. *Corolla* white small 1½ inches across, nearly twice as long as bracteoles. *Capsules* ovate pointed.

Origin.—This cotton is distinguished from the other white-flowered varieties by having palmatifid, not palmatipartite leaves and by the small bracteoles.

Except in the colour of the flowers the three Panjab cottons—the white flowered, the red flowered *Narma* and the yellow flowered Rawalpindi—are much alike, the red-flowered plant is a tolerably pure member of the arboreum group and the white and yellow flowered races are possibly crosses with G. roseum and G. indicum respectively.

VII.—COTTONS OF THE NORTH-WEST PROVINCES.

I received two samples of cotton seed from the North West. The first from the Saharunpore gardens was labelled "Country cotton." It proved to be a mixture of four varieties already described. The majority of the plants had yellow flowers and palmatifid leaves like Rawalpindi cotton.

it was a variety of Todaro's G. neglectum free from admixture.

N W PRO VINCES' COTTONS

(27) *Cawnpore Cotton.*

Description —A pyramidal, little branched bush, 2' 6"—3' high, branches thin ascending *Stems*, petioles &c, reddish in colour covered with short simple hairs *Leaves* palmatipartite, 5—7-lobed, lobes lanceolate, mucronate, extra lobe in sinus common, young hairs pubescent with both simple and stellate hair ... 'han in Broach cottor ... ilar. *Stipules* $\frac{3}{4}$" lineal ... very numerous, 3—5 ... on tertiary branche ... ply toothed not enl ... vith 3 glands at the base *Corolla* $1\frac{1}{2}$ times length of bracteoles, bright-yellow with a deep- ... 1" ... ieter, rapidly turning pink on fadi ... b-acuminate with a short sharp ... than the bracteoles *Seeds* 5—7 ir ... a marked beak on the hilum, fuzz very short, dark ashy grey, cotton firmly adhering to the seed, staple short, floss soft and moderately silky

This cotton is nearly related to the *Burdya* cotton of Bengal and is possibly identical with it

VIII.—RAJPUTANA COTTON *

(28) *Jeypore Cotton, Variety A.*

(28) *Description* —Tall slender bushes, 4—5 feet high, stems, petioles, &c, pubescent, young leaves thickly felted with large stellate hairs, old leaves nearly glabrous *Stem* more woody than in Broach, strong, erect; branches few *Leaves* slightly to obsoletely cordate, palmatifid, mostly 5 lobed, upper leaves 3-lobed, lobes narrow, ovate acuminate; margins ciliate but not sinuate, sinus rounded or folded, extra lobe frequent in the sinus, midrib generally eglandular. *Petioles* $\frac{3}{4}$ as long as the leaf blade *Stipules* $\frac{3}{4}$ inch linear *Flowers* not numerous, usually on the secondary branches *Bracteoles* roughly triangular, slightly to deeply dentate, soft and hirsute when young, united at base large and enlarging in the fruit *Calyx* crenulate, markedly gland-dotted with large glands at the base *Corolla* small about as long as the bracteoles, very pale yellow or white with a purple base, rapidly turning pink on passing maturity, convolute *Capsules long*, ovate acuminate or elliptical acuminate 3—4 celled, cells 7—10 seeded *Seeds* medium size, ovate with sharp beak on hilum, fuzz very short, brownish or whitish brown, wool white, moderately silky but short stapled.

(29) ***Jeypore Cotton, Variety B,*** differs only from "A" in the ... lobes lanceolate, acute, Petioles half the length ... ginated in a cross be- ... e shape of the leaves, sembles G. roseum, it ... and in the seed, the ... races, in the leaves, ... e of Jeypore cotton is paler than that of the white flowered tribe, it resembles the soft mossy green colour of the Gujarat cottons

* In forwarding me a sample of cotton seed from Jeypore the sender remarked that there was only one variety grown in the neighbourhood, and that it received no special vernacular name other than "*Kapas* Upon growing it, however, I found that Jeypore Cotton was a mixture of two closely related varieties.

RAJPUTANA COTTONS.

(30) ***Wild Cotton from Marwar.***—I examined this cotton at the Poona Farm. Seed had been obtained from the Forest Superintendent of Marwar.

Wild cottons.

[illegible] -hes, 2½—3½ feet high; branches weak [illegible] the jungle. Young stems, petioles, young leaves covered with stellate [illegible]. Stem red [illegible] —5-lobed; [illegible] act leaves obtuse short, not constricted at base; extra lobe in sinus occasionally. *Petioles* half the length of the leaf-blades. *Stipules* linear, those on peduncles unequal. *Bracteoles* ovate dentate united at base, veins marked. *Calyx* crenulate. *Corolla* small, 1½ inches across, yellow with purple base. *Capsules* mostly ovate acuminate but various, some almost globose, 3—4-celled; cells 5—7-seeded; seeds moderately large with greenish brown fuzz; lint firmly attached to seed, white, but short, coarse, and woolly.

Origin.—This wild cotton was being grown under the name of G. [illegible] with the plant growing at Poona. The [illegible] corolla is larger, th[illegible] tawny tinge; with t[illegible]

IX.—SIND AND PERSIAN COTTONS.

(31) ***Two Sind Cottons.***—Cotton seed obtained from Hyderabad Sind produced plants of two varieties, the one was a white-flowered form with palmatipartite leaves resembling the *Nurdki* of Bengal, the other is described here.

Description.—*Stems* brownish covered with short scattered simple hairs. *Leaves* slightly cordate, palmatifid, 3—5-lobed; lobes ovate, constricted at the base, [illegible] lobe in sinus common; [illegible]; young leaves pubescent; [illegible] rly glabrous, hard and leathery. *Stipules* small and linear. *Petioles* ¾ as long as leaf-blade. *Flowers* numerous, 3—5 on secondary or tertiary branches. [illegible] and paler flowers.

[illegible] accidentally been mixed with the Marwar supply.—*Editor.*

† I have not examined the seeds of this cotton.

SIND COTTONS

(32) *G. Stocksii, Mast.* ... strag-
... *Stems*
... minate

Petioles equal to leaf-blades *Leaves* deeply cordate, palmtifid 5-lobed; lobes rounded ovate, obtuse mucronate, young leaves with simple and stellate hairs not felted as in Broach cotton, full-grown leaves with a moderate number of branched and stellate hairs on both veins and mesophyll; old leaves with scattered stellate hairs, fairly numerous and with few or no simple hairs even on the ribs, midrib glandular. *Flowers* borne on secondary branches on very short peduncles $\frac{1}{8}''$ long, two or more flowers on each branch, at the base of the flowering branches entire orbicular leaves are sometimes found. *Bracteoles* deeply gashed as in G barbadense and separate to the base, from 9—13 teeth enlarging in the fruit; glands at the base marked, veins are well marked *Calyx* with five small teeth. *Corolla* yellow with red base, in the small stunted plants examined 1" across, $1\frac{1}{2}$ times as long as the bracteoles. *Stigma* united *Capsules* 3-celled, ovate acuminate.

Except in the gashed bracteoles G. Stocksii does not resemble G. barbadense, and I believe its nearest relative to be G herbaceum

(33) ***Persian Cotton.***—Small, much branched bushes, herbaceous in character, with soft green stems, petioles, &c, like those of the Gujarat annual cottons and bright-green foliage with pale green veins as in the leaves of *Wagria*; sparsely covered with hairs which are either simple or branched, none stellate as in Indian cottons *Petioles* as long as, or longer than, the leaf-blades, sparsely covered with long delicate hairs *Stipules* linear acuminate, sometimes falcate *Leaves*, 5—7-lobed, palmatifid, deeply cordate; lobes constricted at the base and rising up in a fold, ovate mucronate, the sharp point is well marked on all the lobes; lobes of upper leaves markedly obtuse, ...
thickly covered with simple and branched ...
and the old leaves are almost glabrous ...
hairs on the veins; midrib and rarely other ribs glandular. *Flowers* on short peduncles on secondary branches *Peduncles* short sub extra axillary. *Stipules* on peduncles markedly unequal, one toothed *Bracteoles* almost oval in outline, divided to the base of the ears, deeply cordate, inciso-dentate teeth acuminate, spreading after flowering. *Calyx* narrow, crenulate, green, large glands at base *Corolla* small, $1\frac{1}{2}$ times length of bracteoles, not opening fully, pale-yellow, purple patches at base pale. ... of black glands.*

[illegible]

... the obtuse leaves and the gashed bracteoles it recalls G. Stocksii.

X—ASSAM COTTONS.

I received samples of seed from about a dozen different districts in Assam and grew all of them, but the change from the climate of Assam ... minute distinctions showing ... differences between plants, ... try; e g, Mr Darrah in his ... mic Products, IV, 141, men-

* I have not examined the seeds of G. Stocksii nor the capsules and seeds of Persian cotton.

† I should describe G Stocksii as densely coated with stellate hairs.—*Editor.*

ASSAM COTTONS.

tions a tall and a small variety, but in Baroda all the varieties were abou the same size. The most interesting point about Assam cottons is the particularly strong family likeness that runs through the group The Assam region appears to have been the home of G. roseum or of a species that corresponds closely with Todaro's description of that plant, and it is probably from an Assamese stock that the inferior, but prolific *Varadi*, *Katil Belati*, *Mathia*, etc., have sprung The deeply-cut leaves, large bracteoles, pale flowers, long bolls and coarse white wool are common to all these cottons

(34) ***Bungai Cotton*** (in the Dictionary of Economic Products this name is spelt Bhugai) Samples of the seed were obtained from Karimganj and Habiganj, Sylhet.

Description—Erect and little branched plants standing 2 feet high, young parts of stem, petioles, etc., scantily covered with simple hairs, youngest leaves with stellate hairs, older leaves almost glabrous Branches reddish, ascending or spreading. *Leaves* slightly cordate, palmatipartite to palmatisect, leaves of the main stem palmatisect, 5—7-lobed, lobes lanceolate, or linear lanceolate, acute, markedly constricted at the base, other leaves as in *Varadi*, sinus wide, extra lobe rare, midrib occasionally glandular *Stipules* falcate larger than in the G herbaceum cottons, those on peduncles unequal *Flowers* several on secondary or tertiary branches *Bracteoles*, large, ovate acute, dentate or entire, united at the base, ears prominent, enlarging considerably in the fruit *Corolla* small, a little longer than the bracteoles yellow white with a purple centre, convolute *Stigmas* united *Capsules*, 3-celled, ovate acuminate, about 1¼ inches long, cells 7—8-seeded, seeds moderately large; hilum beaked, fuzz thick, greenish white, wool short and coarse, white firmly adhering to the seed

(35) ***Bhoga Kapa*** from Sibsagar closely resembles *Bungai*, it differs in having smaller seeds with a long beak and in having 9—12 seeds in each cell The cotton is finer than that of *Bungai*.

(36) ***Khausa*** from North Cachar is another very similar variety with still smaller seeds and with a much finer quality of cotton Compared with the floss of the other Assam cottons, that of this variety is quite silky.

(37) ***Kunma Cotton*** from North Cachar is a larger and more robust plant than *Bungai*, with bigger leaves, flowers, bracteoles and bolls. The latter are acute or acuminate. Seeds, 8—11 in a cell, medium size, ovate with short beak, fuzz thick, greenish white, wool coarse and short stapled.

(38) ***Shet Cotton*** from Lakhimpur—In the habit and leaves this cotton closely resembles *Kunma*, but the bracteoles are more deeply cut, the flowers are smaller and change to pink very quickly on passing maturity, and the bolls, which are 3—4-celled, are much smaller, and pointed but not acuminate Seeds 9—10 in cell, small to medium size, beak with white fuzz, and firmly adhering wool, which for Assam cotton is tolerably fine; staple short.

(39) ***Ukynphad Cotton*** from the Khasi and Jaintia Hills differs from *Bungai* in having much larger flowers which are nearly twice as long as the bracteoles The stigmas are slightly divided at the apex and the capsules are 3—4-celled and pointed but not acuminate, 3 celled bolls are triangular in cross-section Seeds 10 in a cell, small ovate with a moderate beak; fuzz very long, whitish brown; wool short, coarse and firmly adhering to seed

Ukynphad and *Shet* Cottons are much alike except in the fibre.

(40) ***Kil Cotton*** from the Garo Hills.—Habit, hairs and leaves as in *Bungai*. *Bracteoles* smaller than in other Assamese varieties, triangular,

ASSAM COTTONS.

entire or sub-dentate. *Flowers* less than twice the length of the bracteoles. *Capsules* very large, triangular in cross-section, acute; cells 17—18-seeded; seeds large, flattened; beak sharp; fuzz abundant and whitish-brown; wool white, but very coarse.

Concluding Remarks Regarding Assam Cottons.

In several of the Assamese plants and especially in the *Kil* variety, the floss is matted so that the seeds are not readily pulled asunder. When the capsule opens, the cotton bursts out and hangs down for several inches from the branches; against the dark-green foliage the appearance is effective and most peculiar.

From the Ghir Hills in Kathiawar some seed cotton was brought me having precisely the same woolly matted character that distinguishes *Kil* [illegible] of the Assam se[illegible] from whom it [illegible] ad sown some [illegible] ther he nor any of his [illegible] nds its way to the [illegible] a *Varadi* plant had reverted to the character of its ancestors when growing wild in a hill climate.

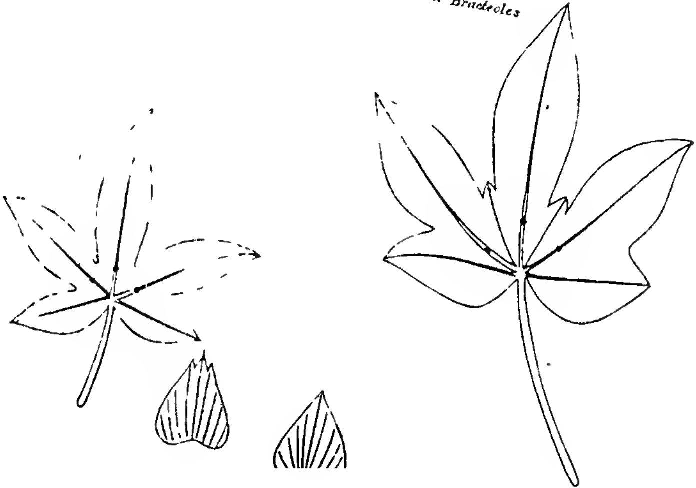
XI—MISCELLANEOUS AND FOREIGN COTTONS.

In addition to the foregoing plants there are several cottons which in a semi-wild or cultivated state are found in most parts of India. With the exception of G. hirsutum none is a field crop. They are described below.

(41) G. arboreum, *Linn.*—A tall shrub with thin branches and red flowers. *Stems*, branches, petioles, leaf-veins, peduncles, and bracteoles, reddish-purple; branches, petioles, etc., with scattered simple hairs. *Leaves* slightly cordate, palmatifid to palmatipartite, usually 5-lobed; lobes lanceolate to narrow [illegible] be common in sinus, midr[illegible] never sinuate, leaves quite [illegible], buds with numerous stella[illegible] abrous. *Petioles* nearly equal [illegible], semi-falcate, those of pe[illegible] all and rounded. *Flowers* fe[illegible] s small, ovate, sub dentate or entire. *Calyx* truncate or sub-crenulate, shallow, with glands at base marked. *Corolla* twice the length of the bracteoles, deep red, opening fully. *Stigma* eglandular, slightly fid. *Capsules* mostly 3-celled, ovate acuminate, when 4 celled sub-globose; cells 6—8-seeded. *Seeds* covered with green fuzz; floss adhering loosely to seed, scanty, weak but silky.

This cotton is never cultivated in Gujarat and no pure form of it, so far as I am aware, is grown as a field crop in India. The cultivated *Narma* of the Panjab has the same colouring, but differs in several important respects from G. arboreum and is a hybrid variety. This species is now rarely met with in Gujarat gardens and must be much less common than when Vaupell wrote 50 years ago. It is called *Narma* or sometimes *Dev-Kapas*—names by which G. barbadense and G. brasiliense are also known.

(42) G. barbadense, *Linn.*—A much-branched glabrous perennial shrub from 6 to 10 feet high. *Stems*, branches, petioles red. *Leaves* cordate, 3—5-lobed, the majority 3-lobed, less than half cut, lobes triangular,



[illegible] Types of
Leaves and Bracteoles

MISCELLANEOUS AND FOREIGN COTTONS

markedly acuminate mucronate; midrib and occasionally side ribs glandular *Petioles* thickened at the base as long as the leaf blades. *Stipules* lanceolate, semi-falcate, reddish, those of peduncles sub-equal *Bracts* often entire. *Flowers* usually 2—3 on short branches *Peduncles* extra axillary, trigonous, shorter than the bracteoles *Bracteoles* ovate, separate almost to base, deeply cordate, laciniate, with glands at the base less marked than in *G hirsutum* *Calyx with truncate teeth*, glands at base not nearly as well marked as in Indian species *Corolla* yellow in bud, yellowish-white in flower, rapidly turning reddish-pink on passing maturity, slightly longer than the bracteoles *Stigmas* with marked double rows of black glandular dots, united but not clavate as in G. hirsutum *Capsules* mostly 4-celled, ovate, shorter than bracteoles, small compared with those of G. hirsutum, cells 7-seeded *Seeds* black, free from fuzz except for a small tawny tuft at the hilum, floss long-stapled and silky, but weak

This cotton is never cultivated in fields, but is occasionally grown in gardens along the water channels and boundaries Stray plants are very common, and almost every large garden contains one or more The crop is usually destroyed by boll worm and other insects

(43) G. hirsutum, *Miller* *—Low-branched annuals *Stems*, petioles, etc, red and covered with simple hairs *Leaves* large, deeply cordate, palmatifid, usually 5 lobed except bracts which are 3 lobed, lobes ovate, not constricted at the base, acuminate, sinus rises up in a fold, but no extra lobe, midrib glandular, buds pubescent, hairs mostly simple, or branched, a few stellate, old leaves much less hairy than in the Indian representatives of G. herbaceum *Stipules* broad, linear falcate those on peduncles sub equal *Petioles* nearly as long as the leaf blades *Flowers* 2—3 on secondary branches *Peduncles* very short, extra axillary, trigonous much thicker than [illegible] from ⅓—⅔ as long [illegible] with 3 large well [illegible] greenish-white, [illegible] white when open, rapidly changing to reddish pink, delicate in texture, *membraneous reticulate*, petals cuneate *Filaments longer than in Indian* cottons *Stigmas* entire, clavate, glandular *Capsules* mostly 4 celled, globose or elliptical with a very short blunt point, much larger and more rounded than in G barbadense, cells, 7-seeded *Seeds* ovoid, large, with long thick ash-coloured fuzz, beak short, floss white and silky, but short-stapled

Seed of this cotton was sent to me from Bengal and said to be that of a very good variety cultivated as *Malgacha* It is a prolific and useful cotton which ripens in 5—6 months (later than most American annual cottons), it grows very well on a sandy loam soil

Except for a few stellate hairs on the leaves, and the fuzz on the seed which is not always present even in cultivated races of G. herbaceum, *e g* (*Tellapatti* from Bellary), I see nothing to connect this plant with the herbaceous cottons of India It differs markedly from G herbaceum in [illegible] bracteoles glands, calyx, corolla, and stigmas, and [illegible] distinct traces of an Oriental origin [illegible] perennial cotton with tawny floss, in [illegible] *Stems* petioles etc., red and sparsely covered with simple hairs *Leaves* cordate, 3—5 lobed, 5 lobes more frequent than in G barbadense, lobes deeper cut than in G barbadense,

* At my suggestion Mr Middleton has adopted G. hirsutum, *Miller non Linn* as the correct name for this plant G. barbadense above should similarly be G. barbadense, *Linn, Sp Pl non Herb.* See concluding note.—*George Watt, Ed*

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palmatifid as in G. hirsutum, but triangular acuminate, seldom ovate; hairs as in G. hirsutur
G. barbadense.
ous, extra axill.
Calyx
lla pale-
fading.
acteoles
ovate, much longer than in G. barbadense and not globcse as in G. hirsutum; cells 6—8-seeded. *Seeds* covered with a long tawny *fuzz*; beak *short*; floss tawny yellow; staple short.

Roxburgh describes the stipules as being cordate; when the stipules at *the base of the peduncles are* detached the insertion is cordate, as it is in G. barbadense, the insertion of the ordinary stipules is straight.

This cotton is not cultivated. Except in the perennial habit and tawny floss G. religiosum, *Roxb*, is closely allied to G. hirsutum, I believe the former to be simply a naturalized and perennial variety of the latter.

(45) G. *brasiliense*, *Macf.*—A large shrub *occasionally 15 feet high*. *Bark* smooth brown; *herbaceous portion of stem*, petioles and peduncles glabrous and covered with elliptical glandular dots. *Leaves* deeply

a few thin simple or
at the ends of the
cotton *Peduncles* nearly as long as leaves, swollen at base. *Stipules* linear to lanceolate acuminate, *those on peduncles unequal*. *Flowers* solitary. *Peduncles* extra axillary, on secondary or tertiary branches, trigonous. *Bracteoles* large in flower and enlarging in fruit to 2" × 1¼" or more, deeply cordate, ovate, laciniate; glands at the base marked, as are also the glands at the base of the calyx. *Calyx* truncate. *Corolla* yel
or
ion of
G. acuminatum, and I think that G. brasiliense and G. acuminatum are synonymous.

The *species is never* cultivated, but is not uncommon in gardens where it usually goes by the name of *Dev-Kapas*.

THE IMPROVEMENT OF INDIAN COTTONS.

Although this paper deals with Indian cottons as they are, not with Indian cottons as they should be, it may not be out *of place to offer a* few suggestions on their improvement.

Apart from changes in the general system of cultivation which in different districts must be of very unequal merit, there are three methods
cotton: (1) Selection of seed, (2) Hybri-
cottons for which this seems the
; to cross them with other kinds
f their valued properties, *e g*, if
the best of our Indian

* Compare with page 12.

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less productive and less able to resist the excessive moisture to which his fields are subject in the monsoon, and if it were crossed with any of the other Indian species, the value of the staple would certainly deteriorate. Since he has a sufficient (generally more than sufficient) supply of rain in the monsoon, a deep-black soil which retains moisture for months, and—until the end of February—a moderately humid atmosphere, there is no plant that suits him so well as the race of G herbaceum he calls *Deshi*, and the only way to improve his cotton is by careful culture and selection of seed

Unfortunately selection of seed, although a certain method of improvement, is a slow process and one which only yields appreciable results after a more or less lengthy term of years, and unless the selection is maintained the crop will soon deteriorate to the old level It is on this account that selection of seed, which is almost universal in gardens, is comparatively rare on farms The farmer chooses good, sound and healthy seed, but he seldom finds that the careful selection which repays the gardener is suited to his business The ryot knows that the most carefully-picked seed is as nothing to the crop compared with clean soil or manure or a good season, and although he does select *Jowari* I am afraid that it would be difficult to get him to take the small amount of trouble that the collection of the best cotton seed would render necessary At the same time there is not much danger that *Varadi*, or any other form of 'Bengals' will invade the cotton plains of Broach and Surat, for the cultivators know the value of their own plants very well, they do not wish an early variety, and if a stranger appeared they would remove it when weeding Even if the ginners purchased 'Bengals' and mixed the seeds in ginning the cotton, I do not think that the Broach crop would become mixed, for if the practice became general at the gins the culti- [illegible] districts [illegible] other- [illegible] ill take [illegible] I question whether they will be induced to do so for the improvement of an unmixed variety.

The selection of the seed of Broach cotton will be undertaken at the new Government Farm at Surat, and if the process proves successful, steps will no doubt be taken to induce the ryots to take up the work for themselves.

Hybridisation.—For the Broach and Surat Districts of Gujarat and for [illegible] entry of G. roseum and its depraved offspring and to provide new and better cottons suited to the districts. New and better cottons might almost certainly be got by crossing selected species and by carefully selecting the hybrids produced.

[illegible] careful selection [illegible] In 1892, I [illegible] respondents, [illegible] part I give some extracts—

Professor Tracey, Director of the Mississippi Agricultural Experiment

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Station, writes. "I ... There is no trouble whatever in crossing differ ...

I have secure ... two species, but they are somewhat difficult to obtain, and, so far, have not proved to be of much value. (2) The larger part of our improved varieties have been obtained by selection, though many of them are doubtless natural crosses (3) We have both G. barbadense and G herbaceum in cultivation here, though usually ...

coast, ...

Pro ...

Station ...

of Indian, Mexican and West Indian cottons. I am not sure of this, however, and am continuing my examination of it"

Mr Gustave Speth, Horticulturist, Agricultural Experiment Station, Georgia, remarks that until recently American selectors of cotton-seed were content to work with the products of chance cross-fertilization, and he adds "In such a case all improvements are accidental; with our present knowledge we go further, we propose carrying on our operations in specific directions, in our work we have always a specific object in view, for ... its or to improve the length of the ... staples Cross-fertilization is only ... the cotton plant Breeding ... tance, as often 4–6 plants of ... the result of the second year's ... crossing by accident) Cotton ... are and study, but it does not mix in the field to any serious extent "Our cultivated forms I consider to be G. barbadense."

Professor Newman, of South Carolina, writes: "I have found the cross-fertilization of varieties of cotton grown in close proximity very slight. In making new varieties more dependence is placed on the careful selection of seed from typical plants than on hybridisation Good results have been obtained by crossing the black-seeded long staple or 'Sea Island' on the more prolific Upland varieties"

... the United States are ... the New World, ... oured districts, is going from bad to worse, and the production of new varieties to take the ... to chance. ... experiments on the artificial ... aken at existing Government ... provided proper supervision existed.

What we want in India at present is a cotton that suits clay soil, ripens with ... *Bani* of the ... but it is ... and very inf ... to preserve ...

* The G. herbaceum of American authors is G. hirsutum, *Miller*. See concluding note.—*George Watt.*

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many parts of India, the other too late; a combination of their properties colour, both plants grow on clay soil, but one ripens early, too early for should produce a cotton that would combat the advance of 'Bengals' more effectively than "Ashburner Acts" or any quantity of "Cotton Frauds" legislation

The ryots' sole object is to get as many rupees for his crop as he can, and he cannot be expected to cultivate a worn-out and delicate plant,

great majority of seasons, to produce a crop of G herbaceum, the first-class cotton land of India. Soils like those of Kathiawar, Khandesh, Berar and the Central Provinces which in the past or still produce G, herbaceum or G. indicum, but on which these crops are precarious, and are giving place to inferior sorts, may be termed second-class cotton soil. There remains a very large area of third-class cotton land which is too sandy or has too small a rainfall to ripen any of the finer races, on this land the perennial cottons of Gujarat and Madras and the bulk of the 'Bengals' of commerce are raised From the commercial point of view nothing could be much worse than the fibre produced by this third-class soil, and there is a very large field for improvement.

For inferior land it is essential that we have a quick-ripening (4—6 months) cotton and for the rest the finer, whiter and more abundant the fibre the better. To secure a cotton for light soils and dry climates,

indicum might possibly be introduced with advantage into districts which have hardly sufficient rainfall to ripen the G herbaceum now grown there. It would certainly be better to have *Bani* than the *Varadi* which threatens Kathiawar, but better than either would be a cotton combining the characters of *Bani* and Broach *Deshi*.

Whilst there is little that can be done in the acclimatising of indigenous

* Okra leaf cotton seems to me to combine the characters of G hirsutum with those of G roseum

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isolated districts of Bengal, the Punjab the C...
Kathiawar, G. ...
is a d...
soils ...
but w... ...soil it grows well. Its
great ... it ripens in 4—5 months, grows on light soils unfit to produce the better classes of Indian cotton, and consequently where it *succeeds, it would take* the place of our worst kinds I have grown about a hundred cottons received from all parts of India at the College Farm, Baroda, and none has done better than an ...
sent to me from Bengal, G barb...
... Gujarat, but nowhere

By ... have indicated and especially by hyb... of the ...
India ...
even she has known before ...

... most persistent ... in the Bombay Presidency were those of Elphinstone who succeeded ... ...ense and G. herbaceum with c... value. The ...
of Pro... ...
G barbadense wa...
with respect to the ... um, nothing short of actual trial ... experiment is one which is worth ... capable of being crossed without ... ire of, would certainly be valuable

The small success which has attended the numerous attempts made by Government to improve Indian cotton has undoubtedly been due to the neglect of the native species, and before any general attempt at improvement is again made, the botanic... of the Indian races must be thoroughly ... are merely of a preliminary descripti... Government Farms will take up and ... should collect all the varieties of cotton known in its own province, grow them side by side and publish descriptions Whenever practicable, ... field crops in their own districts as well ... a year or two, a complete ... nd Government would be in a position to deal with the general improvement of the fibre.

For the future cotton plant of all the finest cotton soil of India we must depend upon indigenous races These races are by no means few, and among them there are varieties of great merit, varieties which in the past, even when *left to chance*, have *developed celebrated fibres* But the day is past when any cotton-growing country can afford to depend on chance The increased attention which America is giving to the production of new varieties and good seed is sure to make its influence felt in the market Egypt will follow the United States, for her cottons all come from the New World, and if India neglects the improvement of her indigenous varieties, the prospects of her cotton industry are not encouraging.

The existence of a large quantity of machinery constructed for dealing with short-staple cotton gives an artificial value to the inferior growths of this country at the present time, but in view of the abundant supply of superior cotton now in the market, it is likely that as these machines

wear out they will be replaced by others made for a longer staple, and consequently that the demand for the poorer qualities of cotton will greatly diminish; cultivators will then find that *Varadi, Jari* and other prolific short staple varieties are not the profitable crops they now are, and they will wish, when it may be too late, that they again possessed the superior kinds that have been, or now are being, driven out of cultivation

CONCLUDING NOTE

Concluding Note by the Editor

During the cold season of 1893 I had the pleasure to enjoy [illegible]

Baroda together with supplies obtained from other parts of India His remarks above, constitute a most valuable contribution to our knowledge of the cotton plants of India They incorporate his continuous observations and are particularly valuable as denoting variations in form due to altered environment When I add, therefore, that I do not accept some of Professor Middleton's botanical interpretations I should not be regarded as wishing in any way to detract from the value of the above paper. The subject of the origin of the cultivated races of cotton in the world, is a problem which unfortunately has its parallel if not its origin in the obscurity that involves the determination of even the species of Gossypium. While a very large proportion of the cotton area of India still remains to be explored by me, I do not propose to publish my peculiar views of the botanical problems briefly touched on by Professor Middleton I may [illegible] own [illegible] ven [illegible] in [illegible] If, therefore, uncertainty exists as to the exact plants meant by Linnæus under such names, for example, as Gossypium barbadense, G. hirsutum and even G arboreum, it is no wonder that numerous subsequent writers have got hopelessly confused and new names such as G. obtusifolium, G indicum, G. Wightianum, G. roseum, and G. neglectum have been proposed and rejected or translated from one form to another. The writer had the pleasure recently to receive a large and valuable collection of botanical specimens of Gossypium from the United States of America These proved of exceptional interest since they revealed the fact that G. harbaceum of American writers was for the most part neither the G herbaceum, *Linn Sp. Pl.*, nor G. herbaceum, *Linn Herb* The interest in this matter turns mainly in the interpretation that must now be placed on the so-called American hybrids between that species and G barbadense. Indeed it is from an exactly similar reason that the whole problem of the solution of the species of Gossypium calls most urgently for solution Until we are in a position to say so and so are definite forms, varieties, or species, we are not in a position to propose the steps that should be taken in the direction of improvement of stock.

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(Vegetable Product Series, No. 16.)

THE

AGRICULTURAL LEDGER.

1895—No. 9.

AL DYE—MORINDA.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., Pt. I., M. 651–716.*]

An Enquiry into the present condition of the Al-dyers and of the growers of Al-root: also some remarks on the origin of the form of Morinda *known to botanists as* M. tinctoria; *together with an account of a new and simple process of utilizing the Al-dye,—by* THE EDITOR.

Other DICTIONARY articles that may be consulted.

Bixa Orellana, *Vol I*, B. 533.
Cordia Myxa, *Vol. II.*, C. 1933.
Curcuma longa, *Vol. II*, C. 2477.
Ricinus communis, *Vol. VI, Pt. I.*, R. 371.
Symplocos racemosa, *Vol. VI., Pt. III.*, S. 3064.
Symplocos theæfolia, *Vol. VI., Pt. III*, S. 3077.
Terminalia Chebulia, *Vol VI, Pt. IV*, T. 329.
Woodfordia floribunda, *Vol VI, Pt. IV.*, W. 108.

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OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

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E C BUCK,

Secretary to the Government of India

(Vegetable Product Series, No. 16.)

THE

AGRICULTURAL LEDGER.

1895—No. 9

AL DYE—VARIOUS FORMS OF MORINDA

[*Dictionary of Economic Products, Vol V*, M. 651—716]

An Enquiry into the present condition of the Al dyers and of the growers of Al-root also some remarks on the origin of the form of Morinda known to botanists as M tinctoria; together with an account of a new and simple process of utilizing the Al-dye,—by THE EDITOR

Botanical considerations essential

The specific name tinctoria having been assigned by Roxburgh to one of the forms of Morinda, many popular writers (and very naturally so) have presumed that the cultivated dye yielding plant was M. tinctoria. But it transpired subsequent to the publication of Roxburgh's work that the chief source of the dye was a species named previously by Linnæus as M. citrifolia. Any species of Morinda may, however, afford the dye but in varying proportions, higher in the cultivated forms than in the wild This circumstance has rendered it necessary that in every attempt that may be made to advance the interest concerned in *Al* dye the very greatest care and attention should, for some time to come, be paid to botanical considerations It would obviously result in disappointment and failure were carefully selected specimens to be sent to the chemist, but the practical dyer furnished subsequently with inferior Morinda—supplied in fact with roots that afford a very much smaller amount of dye than those examined by the chemist. In the experiments hitherto performed in Europe it has frequently happened that the practical dyers results have to all intents and purposes discredited the chemical investigations This has been due to either of two circumstances—(*a*) ignorance in Europe of the method necessary to obtain the red dye from the roots, and (*b*) ignorance in India of the fact that there are various forms of Morinda and therefore, various qualities of the roots, some of which may contain little or none of the red, for which the roots are valued

MORINDA

Present condition of the *Al* dyers

Failure in extracting the dye.

Conf with p 20

As an example of the former reason of failure, mention may be made of the circumstance that Mr. Thomas Wardle of Leek, one of the most enlightened and experienced of dyers, failed absolutely to discover the red dye in an extensive series of samples of *al*-roots sent to him for experiment He was of opinion that the Natives of India must use *manjit* (Rubia) along with their *al*, and consequently was led to affirm that the former must in that case be regarded as the source of the red colour But on his visiting India Mr Wardle obtained abundant evidence that the *al* roots do actually yield excellent reds and his subsequent experiments abundantly confirmed the Indian experience

Future of Al-dyeing industry

Conf with pp 19-20

Since the date of publication of the Dictionary, large commercial samples of some of the chief kinds of *al* roots have been furnished by the Government of India to the Imperial Institute, London These have been subjected to careful chemical examination by Professor Hummel and Mr Perkin of the York College, Leeds The result has been that these chemists have published a scientific explanation of the principle involved in the isolation of the red dye. The possibility, therefore, of a trade with Europe in Morinda dye has been advanced very materially No dyer need now fail to obtain the red principle, and the development in the future of a large Morinda industry may accordingly be said to turn on certain Indian considerations such as —First, whether it will pay to cultivate the *al* root as an article of foreign export, second, for Indian investigators to discover which species and what forms of that species afford the greatest amount of dye, and are, therefore, the plants that should be cultivated, third, to ascertain whether the yield of dye from the more prevalent wild species is sufficient to justify the attempt being made to create a trade in this as an article of forest produce, fourth, to find out the area over which Morinda cultivation could be profitably extended, keeping in view of course the influences of climate and soil on yield of dye, as also the facility of transport to the seaboard

Prospects of a foreign market

Were it possible to organise a foreign trade, an incalculable boon would be conferred upon a class of cultivators, who through the extension of the use of aniline dyes may be said to have been ruined The Indian trade in *al* dye having been practically exterminated within the past few years, it becomes a matter of the greatest importance to India to definitely ascertain the prospects of a foreign market for the root

The botanist and chemist to aid each other.

While, therefore, the chief responsibility of future developments rests for the present upon India, the aid of the chemist cannot be said to be unnecessary. There are, as it seems to the writer, at least two directions in which the contemporaneous researches of the chemist are indispensable Indian officials must see that they collect certain well known roots, not as in the past bazar or commercial samples These will have to be accompanied with carefully preserved botanical specimens, so that the botanist may be able to furnish the chemist with the racial or specific names of the plants under his investigation By this means it would be possible to discover the varying yields of

European enterprise necessary

dye in different species, varieties, or races, both of the wild and of the cultivated plants, as also of the influences of environment on these forms The co-operation of the chemist in this enquiry is essential, but he can render an even greater service Past experience in Tea, Indigo, Jute, Cotton, Silk, etc, has abundantly shown that if an Indian industry is to be greatly expanded it must enlist European capital and enterprise Remarkably few Indian industries that have remained in the hands of the Natives during, say, the past half century of India's commercial development have made any tangible progress This is doubtless largely due to the ignorance of the people of India in the principles by which alone large and prosperous undertakings are controlled In their agriculture they are peasant farmers, and in their manufactures they are village artizans With both these classes it is only too frequently the case that the governing principle is immediate gain, and hence adulteration is often exalted into a science, instead of being viewed as an absolute barrier to gre[illegible] If therefore, Morinda has any chance of [illegible] it at present holds into that of one [illegible] cts, it would almost seem as if the chemist would have to discover a process [illegible]

Prepared dye needed for export.

[illegible] seen below has practically been discovered by Hummel and Perkin, for these distinguished chemists may be said to have not only removed the chief difficulties hitherto experienced by European dyers in the utilization of *al*, but laid the foundation of further possible developments in the direction indicated In India it has not as yet been found remunerative (with few exceptions such as Tea, Coffee and Indigo) for European capital to be directed to purely agricultural undertakings Unless, therefore, some opening be afforded for European enterprise to pioneer the new industry, it is hardly to be expected that much progress would be made even by half a century of continued demand from Europe, for the supply of roots of a uniform quality

Insecticide properties of the dye

But in concluding these introductory remarks, it may be said there is still a third direction in which the chemist may aid the Indian investigator The opinion is very generally held in this country, and has been so for centuries, that cloth dyed with *al* is proof against the ravages of white ants and other destructive insects This belief is alluded to in the Dictionary (page 265) as the reason why *kharua* cloth is so universally employed by the Native bankers and shopkeepers to wrap around their account books In many parts of India the ravages of white ants are so great that they may be said to destroy the avenues of trees planted along the roads near towns and villages But in some parts of the country the stems are often painted round and round for, say, two feet from the ground upwards with a preparation consisting in some cases of the refuse of the *al* dye works, in combination with garlic and other such ingredients This is said to check most completely the ravages of white ants

M. 651—716.

MORINDA | Present condition of the *Al* dyers

Preservation of trees in Gondal State from white ants

PAINT USED AGAINST WHITE-ANTS

During a brief visit to the Native State of Gondal, the writer recently gave this subject considerable attention. There seemed to be no doubt that His Highness the Takore Sahib, by his enlightened action in this matter, had effected a radical improvement. The trees throughout his State were all painted as described, and not a single tree could be found showing the mud encasements so characteristic of the presence of white ants. And very possibly, as a consequence of the care bestowed on these trees they were healthy and vigorous, while those in neighbouring States were sickly and badly attacked with white ants. In consequence of these observations the writer asked for information as to the composition of the paint which had been used. He was informed that the red colour was merely to indicate the fact that the trees had been painted, and that it was for the most part red ochre. The useful ingredients were said to be as follows:—

Paint used for white ants

1 part *dekamali* gum (the resin of Gardenia gummifera).
2 parts asafœtida
2 parts bazar aloes
2 parts castor oil cake

These are well pounded mixed and kept in water for about a fortnight. When thoroughly united and what may be called decomposed, into a thickened compound, water is added in order to bring to the consistency of paint and the colouring matter then added. The mixture is now ready for use and if thoroughly applied for about two feet will check not only the attacks of white ants, but of red ants and other insect pests. Its effect will last for two years or more. The cost of the preparation comes to about 4 to 5 rupees per 100 trees. But according to the information furnished from Gondal *al* refuse possesses no special properties, from other parts of India the reputation is very general that it is of great value. The red ochre, added to the above preparation may not only be useful as indicating the trees that have been painted, but give a useful consistency, if it does not serve to mechanically hold the other ingredients.

Ochre

Conf with p 15

It would however, seem desirable to have the reputation of *al* as a preventative against the attacks of insects thoroughly investigated, even supposing it be admitted that experience in Gondal has proved that it is of no very special merit as a paint on trees. The system of painting trees (as detailed above) might with great advantage be extended throughout India especially in orchards, and it is even probable that the Tea and Coffee planters might find the system of great value in checking the depredations of insect pests. But there remains the main issue, the importance of this reputed property of *al* dye being thoroughly investigated. If it be actually a fact that it preserves the textiles so dyed from being attacked by insects, that would be a powerful reason for its greatly extended use in all cases where lasting properties were essential. The writer would wish it to be distinctly understood however, that in dealing with the subject of

Useful to Tea-planters

Insecticide properties of Al require investigation

the preventative power of *al* against white-ants, he desires to give greater currency merely to a very generally accepted Native opinion, and one which has not as yet been either confirmed or disproved by scientific investigation

Origin of M. tinctoria from M. citrifolia.

ORIGIN OF CULTIVATED FORMS.

It may be of interest to record here some observations made by the writer during a recent tour of inspection through certain of the *al*-producing districts of the Central Provinces and of the Berars, since these would seem to point to a possible error in the botanical literature of the dye-yielding species of **Morinda** Being familiar, from previous study of dried herbarium specimens of that genus, that grave doubts might be entertained as to the desirability of retaining Roxburgh's **M. tinctoria** as a species distinct from **M. citrifolia**, he was prepared when opportunity afforded to examine critically the various forms met with in cultivation. It may best elucidate the facts dis-

Al grove at Sauoer

ove of

The

cultivators explained that these were from 30 to 50 years old, they were about 40 feet in height These trees were said to have been formerly employed in furnishing seed for a crop known as the *moti* (larger) *al*, and ordinarily fetched about R60 per 400lb of ripe fruits The trees flower in June and were in nearly ripe fruit on the 1st of December When asked when the fruits would be collected, the cultivators replied that there was now no demand for the seed and hence the trees were useless

It may be here remarked that the lower branches of these trees bore See Plate 1.

manifested the difference in the foliage of **M. citrifolia** (the old large

lateral and opposite a leaf in the old twigs, and more or less terminal in the young Indeed the contrast between specimens from the lower and older parts of the tree and from the upper and

but subsequently other samples were procured from trees and the above peculiarities repeatedly verified Of this nature may be [illegible] (Specimens No 13822), at Bailona

0502).

the complaint was made by the

MORINDA	Present condition of the *Al* dyers

ORIGIN OF CULTIVATED FORMS.

cultivators, far and near, that they had been deprived of one of their most remunerative industries—the cultivation of the *al*. They pointed to the neglected trees by the sides of the fields and to the plants of *al* that now spring up all over the fields as useless and troublesome weeds In only one or two localities were actual fields of *al* cultivation to be found. Near Surla, for example, a few fields were inspected These had been sown broad-cast in June, and the plants were in December about 5 to 10 inches in height As these possessed long narrow leaves, very hairy and pale-green, they were at once thought to be M. tinctoria, *Roxb.* Since they were not in flower the cultivators were asked if they could show any older plants of this same form—the *moti al* as it was ... distance as those from ... obtained After collect- ... e marched off to inspect the trees and found these (No 13822) identical with the Sauner trees already described On expressing doubt as to the field plant having been produced from these trees, because, while the trees had large broad sub-glabrous leaves, the field crop had narrow hairy ... the fact that the ... every possible ... "if seed from these trees produce the *moti al*, from what source is the crop known as the *chhoti al* obtained"? The answer received was that it is the same plant under different treatment Fields of *chhoti al* were then inspected, ...

The Moti Al and the Chhoti Al see Plate 2

... therefore to be seen, whereas the *moti al* was in the state of seedlings in their first year of growth. The former were in flower, the latter ...

... and at the same time comparatively narrower than in ... plant The latter has also a strong tendency to produce procumbent or deflexed and arched branches, a peculiarity probably the result of their less woody structure in relation to the weight of fruit that they have to carry.

Origin of Chhoti Al

... was given of the ... ted If seed from ... will produce *moti al*, a form that ... roots (in paying quantity) after the third to fifth year. Many of the *moti al* plants may, however, be seen to flower in the second or third year and so continue in flower very nearly throughout their subsequent growth, ripening fruit in December. If from these plants seed be collected and sown the *chhoti al* is obtained—a plant that may produce its flowers

ORIGIN OF CULTIVATED FORMS

and fruits in twelve months It, moreover, yields a rich crop of the finest of all roots in 14 to 20 months from the date of being sown. The cultivators admitted, however, that they rarely take the *moti al*
s of the
as thus
stock
t rather
which exists under certain methods of treatment It would thus seem that by a process of selection, and as the result of centuries of cultivation, the *al* growers have produced from a perennial tree an annual, or at most biennial, field crop They have altered the nature of the plant by reducing it from a tree 40 feet in height to a bush 6 inches to 2 feet in height Have made it fruit as a biennial and flower not in June only, as in the case of the trees, but from June to December. They have caused it to produce *thin roots with thick* dye-yielding bark and little or no wood. In trade the roots are assorted into three qualities according to size, but the whole of the *chhoti al* crop would be referred to the finest of all qualities, the thinner roots of the
oti al
nparalleled, results,
centuries of know-
ledge should now be in imminent danger of being entirely lost, since the crop is everywhere being abandoned and the annual and biennial stock neglected as a weed which will rapidly revert to its perennial and less valuable condition

Specimen collected

The specimens collected in the fields were as follows —Nos 13821 (*moti al*, seed from the trees 13822) and 13823 (*moti al*, a weed in fields), 13824 and 13825 (*chhoti al*, old plants left for purposes of seed; and 10517 (*moti al* found in fields as a weed of cultivation)

Different forms of the plant.

These field plants have all got the narrow leaves characteristic of **M. tinctoria**, *Roxb*, while the tree form, as already detailed, corresponds as near as possible to **M. citrifolia**, *Linn.*

It was also observed that shoots springing from the roots of old plants had very thick hairy leaves (Nos 13822A and 10502), that answer admirably to **M. tomentosa**, and that here and there among neglected plants many flowers had protruding stamens, thus showing that the so-called species—**M. exserta**—must be regarded as a mere sexual state In this connection it may be remarked that Mr J. F Duthie, (*Field and Garden Crops* of the North-Western Provinces, Vol III, pp 55-57, pl. 89) figures and describes a form with protruding stamens as the *al* plant of Bundelkhand Commenting on this subject
the
by
employed in the extraction of the characteristic dye" According to the observations detailed above, however, the arborescent form, **M. citrifolia** of botanists, should rather be spoken of as the wild state of **M. tinctoria**; and further, the more highly cultivated condition—the *chhoti al*—of the Central Provinces and of the Berars shows, if anything, a closer approximation to the condition of the foliage of the

ORIGIN OF CULTIVATED FORMS

arborescent plant than do the seedlings derived direct from the trees
ig cultivation and the effort to recover
nal.

crop is *usually lateral, but in some* cases, as on the long terminal branches of young trees, the heads of flowers become crowded *together* and *produce* the *condition figured* by Roxburgh as M

So far *has satisfied himself* that the v and of M. **tinctoria** (as described in the Flora of British *India*) *can be no longer upheld, but* that those two so-called species must be reduced to one very protean form—M. **citrifolia**, *Linn.* It is impossible to retain any of the conditions enumerated above as even racial states The plant sports so freely that from the same individual root it would not be difficult to cut typical examples of M **citrifolia**, M. **tinctoria**, M. **tomentosa**, M **exserta**, M. **bracteata**, and even M. **multiflora**. The character of having bracts outside the fruiting head was not observed during the writer's explorations in the Central Provinces, but that character is so unimportant that after witnessing other sports it would not be difficult to believe that a few hours' longer search would have discovered fields of bracteated heads. The many-flowered character of M. **multiflora** was found plentiful in neglected plants (No 13823) which spring op here and there through *Tur* (**Cajanus**) and other tall crops, the branches being elongated and the flowers produced at the

Different forms should be all reduced to M. citrifolia.

ons of life in a
urgh should
with in Nag-
century. *It very nearly follows from* that *remark that* the *whole* of the **Morinda** specimens collected by the writer are forms of M. **multiflora**, or that that species is no longer cultivated in the Central Provinces The majority of the plants seen at the present day do not possess the peculiar inflorescence that gave origin to the name of M. **multiflora**, so that the specific description would have to be greatly modified until in fact it merged into the protean M. **citrifolia** Roxburgh's manuscript figure, however, of M. **multiflora** looks a great deal more distinct from the arborescent M. **citrifolia** than do M **tinctoria**, M. **bracteata**, or M. **exserta** But were a selection of sports figured it would be possible to almost indefinitely multiply the species of this genus It is, however, curiously interesting to find how completely Roxburgh's brief description of the Nagpur plant corresponds with the *chhoti* (lesser) *al* of the present day. He obtained the seed of it in 1801, and "by the close of the same year the plants were in blossom, and in one

Roxburgh's description.

ths, and now
may further
Morinda,
already described and figured by me, grow to be small trees, they generally blossom the first year of their growth if the soil is good and the plants taken good care of." Roxburgh then concludes his ac-

count of M multiflora in these words "This plant is cultivated about Nagpur as the other species are in various other parts of India and for the same purpose' The remark as to flowering will be seen to confirm the observations made by the writer in connection with the *chhoti* and *moti al* field plants It is thus probable that Roxburgh had been supplied with seed of the cultivated races of plants, not the trees The cultivators strongest argument that the *chhoti al* is distinct from the tree form (where that opinion prevails) is generally that, while the tree flowers in June the field plant flowers throughout the year That statement was repeatedly confirmed by the writer and will be seen corroborated by the fact that the specimens of the field plant (collected in December) are in flower as well as ripe fruit

ORIGIN OF CULTIVATED FORMS.

CHARACTER OF THE CULTIVATION AND PRESENT POSITION OF THE "AL INDUSTRY.

CULTIVATION.

It has already been briefly indicated that the *al* industry of the Central Provinces and of the Berars is in a state of rapid decay. Some few years ago *al* cultivation was not only one of the most popular but most profitable of undertakings Many large towns might be mentioned as having derived their entire wealth from some part of the trade These are rapidly falling into ruin and the distress experienced is of course being felt more keenly by the labourers than by the better class members of the community The introduction of aniline dyes (which have entirely superseded *al*) may in perfect fairness be described as little short of a calamity It has reduced to the verge of starvation the inhabitants of large tracts of country and destroyed the artistic instincts of the people over a still wider area While discussing this subject in company with a large circle of cultivators at Anjangaon and several other towns, a series of questions were put, to which the following (among other answers) were given —

Al cultivation on the decline

Answers given by cultivators

1 Cultivation has been entirely discontinued within the past four or five years

2 Formerly 6 per cent of the cultivation of Anjangaon was devoted to *al*, and at Pathrot (6 miles off) there used formerly to be as much as 12 per cent

3 It was a very profitable crop. If four acres were under cotton the yield might come to R60, but *al* would give R150 or more, for each of the years that the crop occupied the soil

4 The cultivation was so profitable that the *al* districts were very prosperous Now the complaint was universal that they were suffering very greatly through the loss of their industry

5 *Al*, after the first year, was not affected any way by superabundance or insufficiency of rain The crop in fact gave no anxiety

6 During the last year of cultivation the demand had so declined that the cultivators gave the produce for nothing to any person who would dig it up and remove it.

7 The seed was procured from the field crop, not taken from the trees, but it was admitted this was more from convenience than necessity They accounted for the existence of rows of trees by supposing them to have grown by accident In other villages the trees

MORINDA | Present condition of the *Al* dyers

DYEING Indian Method In KATHIAWAR

and washed in fresh water and dried Sample No 4998 is the cloth treated in this manner

Third —The cloth is dipped in a mixture of 2lb of castor oil, 2lb of alkali and about 5 gallons of water It is allowed to remain in this for twelve hours Next morning it is taken out, rinsed and dried It is not washed in fresh water Sample No 4999 is the cloth passed through this further process

Fourth —In order to get rid of the surplus part of the castor oil in the cloth, it is every day washed in fresh water and dried for three consecutive days Then for the next three days it is every day dipped in a solution of alkali for twelve hours, taken out, rinsed and dried. On the seventh day it is washed in fresh clear water or running stream and dried Sample No

ire of 8lb of the myrabolan 5012 to 5014) with about

and dried Sample N

Sixth —The cloth

myrabolan powder a

remain in it for a short time Then it is taken out, rinsed and dried Next it is dipped in a solution of 2½lb of alum (sample marked No 5015) in about 5 gallons of water It is taken out at once after it is plunged, rinsed and well dried It is then washed in clear water and dried again. Sample No 5002 is the cloth advanced through this stage

Now the cloth is ready to receive the *al* dye But if it is desired to

stage of myrabolan and alum

1st —A mixture of 20lb of castor oil (country), 2½lb of wax, and 2½lb of the powder of a vegetable oily substance known by the name of "khan khan" (samples marked Nos. 5016 and 5017) is made, and the whole thing is heated, till reduced to a liquid which the cloth is to be printed a and printed on the cloth as required

ons of 1lb of sulphate ons of clear water hour and is then hour This process e wax collects on the surface of the water and is separated. Sample No 5004 is the cloth carried up to this stage

the and this process, next it is dipped in a solution of alum and dried, after it is well dried, it is washed in clear water and dried again Sample No 5006 is the cloth passed through this alum process The printed cloth is now ready to get dyed

Seventh —Lastly, the dyer prepares the *al* dye For this purpose 30lb

and of the growers of *Al*-root. (*M. J. Bharwada*) MORINDA.

"Palwas," Nos. 5010—
specially made for this p
it. The cloth to be dye
heated under fire for ab
is now and then stirred w
time, and the liquid a
washed and dried. Sa
No. 5008 is a coarse cloth dyed, and sample No. 5009 is the printed cloth dyed with this dye. If the simple cloth be required to be black-coloured, it is dipped into a solution of sulphate of iron, washed and dried. Sample No. 5010 is the black-coloured cloth.

The above is These cloths are now used Formerly this was the only ys the cloths dyed and prepared in Europe in markets have occupied its place, and the country trade of dyeing is much depressed. Besides which, the native-dyed cloths are used in petty domestic purposes, such as carpets, bed cloths, etc. Cotton twist is also similarly dyed with this dye, and is employed by weavers only.

The *al* plant is neither produced nor cultivated in Kathiawar, but it is imported here from Guzerat and Central India, etc. The samples of the bazar *al*, its powder-manufactured red dye of the European market, and

* Aniline.

Conf. with

EXAMINATION OF THE DYE BY Professor Hummel AND Mr. Perkin.

Such, then, is the complicated process followed in India, for DYEING.

been published in the Journal of the Society of Chemical Industries The samples of Morinda roots (analysed by these chemists) were furnished by the Reporter on Economic Products through the Imperial Institute, London, and it
tained may be regarded as
tant) contribution toward

MORINDA. | Present condition of the *Al* dyers

DYEING European Method

Hummel & Perkin's experiments

Hummel and Mr Perkin have kindly undertaken to continue their investigations in order to solve the practical question of the varying yield of different forms of Morinda, of roots from diverse climatic localities, from different systems of cultivation and seasons of collection, the object being to discover, if possible the most profitable forms of the plant and the regions where encouragement had best be given to foster a revival of the expiring industry. Already these distinguished chemists have prepared the way for a greatly improved system of using the dye principle than that pursued in India And it is to be hoped they may extend an even more direct helping hand to India by designing a simple process, by which the dye in a half state might be prepared ready for export. The hope entertained in India lies more in the direction of organising a new foreign trade than in any very immediate revival of the now almost extinct industry of *al* dyeing It will be seen from the passages quoted below from Professor Hummel and Mr Perkin's paper that these chemists have most undoubtedly made an advance in that direction by the improvement they have shown to take place through a process of simply steeping and washing the roots In their report on Morinda they begin by reviewing all previous publications and in this part of their paper they trace the European knowledge of the dye from the investigations made by Dr Bancroft about the year 1790—

Bancroft's Results 1790

"On calico printed with alumina and iron mordants, separately or mixed, Dr Bancroft is said to have obtained reds, purples and chocolates, very similar to the analogous madder colours, and equally durable At the same time he considered that it might be profitably imported into Europe, and that it possessed the advantage over chay root, that it was less liable to deterioration during storage

Schwartz & Koechlin 1832.

In 1832 Schwartz and Koechlin also examined this root, under the names *Nona* and *Hachrout** and reported on its dyeing properties to the Industrial Society of Mulhouse, in the paper already alluded to under chay root They pointed out its extreme toughness as compared with ... and hence the greater difficulty experienced in grinding it They ... Rubiaceæ examined by them ... yellow principles of an acid ... washing of the root with cold ... also made it requisite to add a certain propor- ... the bath in order to have a perfectly ... this precaution they ascribed the in- ... They recommended that the root be ... as possible and washed ... ltering the mixture, and ... the filter

Washing the powdered Root

... to the dye bath they added ... weight of the root of carbonate of soda, and having introduced the mordanted material, the temperature was raised gradually to the boiling point. In this manner they were able to obtain on oil and alumina mordanted calico a very full red, which on clearing in the usual manner with soap and stannous chloride, changed to a scarlet resembling the Turkey-red obtained from madder On ordinary calico printed with iron and ... black, lilac, red and chocolate differ-

Their conclusion was that, since morinda root only possessed one third the dyeing power of a medium quality of madder, it could never compete with the latter in the European market

DYEING: European Method

At a later date, about the year 1849, some morinda root was imported into Glasgow under the name of *Soorangee*, with the intention of introducing it as a substitute for madder. It was submitted for trial to some of the most experienced and skilful calico printers of the district, all of whom concurred in declaring it not to be a dye at all, and to be totally destitute of useful applications. Professor Anderson, of the Glasgow University, hearing of this circumstance, obtained a supply of the root, submitted it to a chemical examination and succeeded in isolating from it a yellow crystalline product. Anderson found that this substance did not dye iron and alumina mordants printed and fixed on calico as usual with calico-printers, but cotton prepared with oil and mordanted with *alumina as for Turkey red assumed a dark brownish-red colour, devoid of* beauty. The absence of dyeing properties in this *morindine* is readily explained, *for we now know it to be a glucoside*. When submitted to dry distillation, Anderson found morindine to yield an orange crystalline sublimate which he called *morindone*, and this same substance was also produced by boiling morindine with dilute mineral acids. *Morindone* represents the true colouring matter of morinda root, and accordingly Anderson found it to dye ordinary mordanted calico in the normal manner.

Anderson: 1848

In 1852 Rochleder gave it as his opinion that morindine and morindone were identical with the ruberythric acid and alizarin derived from madder. That this was not the case was first adduced by Stein (*J. Pr. Chem.* 97, 234), and in 1887-88 Thorpe, in conjunction with Greenall & Smith (*Jour. Chem. Soc.* 51, 52 *and* 53, 171), showed conclusively the correctness of Stein's view, and further that the constitution of morindine corresponded to a *tri-hydroxy methyl anthraquinone*, alizarine being, as is well known, a *di hydroxy-anthraquinone*

Rochleder 1852

Experimental Results.—Having regard, therefore, to the extensive employment of morinda root as a red dye-stuff by the Natives of India, and the undoubted difficulties experienced by many European experts who have in the past attempted to apply it for the production of reds, our attention and interest was attracted to this dye-stuff with the view of determining the best method of applying it successfully

Principle involved in Morinda dyeing

Further, although morinda root has already been examined by several chemists and the nature of its chief colouring principle has been established, it seemed desirable to determine the character of those accompanying principles analogous to the yellow substances found in madder, chay root, and munjeet, which from its botanical relationship it might naturally be expected to contain

With respect to this part of our examination the results will be communicated at an early date to the Chemical Society but it may already here be stated that several of the above-mentioned yellow substances have been isolated in the crystalline condition. As to the essential colouring principle it is found to be present almost entirely in the form of the glucoside morindine which in the pure condition proves to be of a somewhat stable character

Now it is well known that the colouring matter of the madder-root is there present also largely as the glucoside ruberythric acid, a substance devoid of dyeing properties with respect to mordants, although it will dye wool and silk a bright yellow colour. Moreover, it is a matter of common

MORINDA	Present condition of the *Al* dyers

DYEING European Method

knowledge, thanks to the researches of Schunck, that the madder glucoside is split up under the influence of acids, alkalis, and ferments into

y connected with the suc-
our first endeavours were
he root by one or other of
madder

Reduction of the Glucoside by Fermentation.

Fermentation experiments were made with several weighed quantities of ground morinda root In one case, presuming some ferment might
ns. of root were merely mixed with
l for five days at a temperature of
with the addition of chalk sufficient
to neutralise the natural acidity of the root Other experiments similar to these were carried on simultaneously with the addition of a small percentage of ground madder root on account of its ferment, yeast was also tried In all cases fermentation took place, and the mixtures were thrown on calico filters drained and washed rapidly with four litres distilled water The fermented roots were dried at a low temperature, and the loss of weight (14—17 per cent) determined

Eventually pieces of calico printed in stripes with alumina and iron mordants were dyed with equivalent amounts of the various fermented root and the root in its original condition The latter scarcely dyed at all, whereas the fermented roots gave fairly good reds, chocolates, and lilacs similar to the analogous madder colours The root fermented with yeast gave the best result In all cases the addition of chalk to the fermenting mixture was injurious It was evident, therefore, that a considerable improvement in the dyeing power of the root had been effected, either by the fermentation or by the washing, but since better results were obtained by other methods carried on at the same time, the fermentation experiments were not continued

by Alkalis.

To effect the decomposition of the glucoside by means of alkalis, barium hydrate was selected, for in the course of the purely chemical examination of the root it was found that not only could the glucoside
ed formed
substances
with lime
water and then washing the whole of the ... substances could be removed, and by a subsequent treatment of the residual root with acid and washing the calcium compound of the morindine could be decomposed and the lime removed, leaving behind a purified root containing only morindine in the free state

For some reason or other the morinda root treated in the above mentioned manner yielded only indifferent results in dyeing, and having regard to the number of operations required and the better results otherwise obtained in a simpler manner, the matter was not further inquired into

by Acids.

Decomposition of the glucoside by acids resolved itself into the preparation of a garancine from morinda root and this was done not only with the root in its natural condition, but after it had been thrice washed for two hours with ten times its weight of water, since this is a usual preliminary process in the manufacture of ordinary garancine from madder
as boiled six hours with three
huric acid then allowed to
water until thoroughly free
, amounting to 37 5 grms,
had a very dark green, almost black colour in the case of the unwashed

M. 651—716,

root, due to the presence in it of chlororubine, the washed root gave 37·7 grms. of a paler green product

On dyeing stripe mordanted calico with *morinda-garancine*, with the addition of 2—4 per cent of its weight of calcium acetate, good colours were obtained

DYEING · European Method. Reduction of the Glucoside by Washing

One other method of improving the dyeing power of morinda root, also borrowed from the madder industry, still remained to be tried Many years ago immense quantities of the so called ' flowers of madder " were made in France by simply mixing ground madder with about 10 times its bulk of water, allowing the mixture to stand 12—15 hours, and finally filtering, pressing drying and grinding the product. Although, no doubt, some fermentation and consequent decomposition of the glucoside took place during the steeping, it has usually been regarded as a mere washing process, whereby certain soluble matters, especially acids like pectic acid, etc., were removed and thus prevented from soiling the dyed colours and the unmordanted parts of calico prints (the so called "whites"), and also from impoverishing the colours by dissolving off some of the mordant The loss in weight experienced amounted to 55—60 per cent., *and corresponding to this the dyeing power was about doubled*

In imitation of the foregoing process then, 300 grms ground morinda root were mixed with three litres distilled water and allowed to stand, with occasional stirring, for two hours, the mixture was then filtered through calico, and the residue was similarly treated a second and a third time, the last steeping being prolonged to 21 hours The waste liquors were perfectly clear and of a dark olive yellow colour These liquors were subsequently boiled for three hours, with the addition of a little sulphuric acid, when a copious dark green precipitate, chiefly composed of chlororubin, was obtained This precipitate was collected washed free from acid, and its colouring power as determined by comparative dyeing experiments proved to be equal to 4 per cent of that of the washed root after drying In similar experiments with other samples of morinda root the precipitates showed no dyeing power whatever

It may be considered, therefore, that little or no useful colouring matter is removed by this washing process, on the other hand dyeing experiments made with the washed and dried root showed that, whereas in its original state it was quite useless as a dye stuff, it had now acquired the property of dyeing mordanted calico to a very marked and useful extent

Re-agents necessary to strengthen the colour. Chalk · Sodium & Calcium Carbonate & Acetate.

Its colouring power was, however, not fully developed until such salts as sodium carbonate or acetate calcium carbonate or acetate, had been added to the dye-bath Similar additions especially chalk, are usual in the case of madder grown on a non calcareous soil, and the yellow colour of morinda root, both before and after washing, evidently indicate that its colouring principle is in the free state, rather than combined with mineral matter, e g, with lime, etc. We may add that the chemical examination corroborates this view On comparing the relative advantages of the above-mentioned salts it was found that in each case their addition to the dye bath was decidedly beneficial The following are the amounts we found it necessary to employ to give the best results 1·5 per cent sodium carbonate (10 aq), 1 per cent chalk, 16 per cent calcium acetate, 16 per cent sodium acetate Chalk, and especially sodium carbonate, may be regarded as the best additions, but excess of either of them is far more injurious than in the case of calcium and sodium acetate, whose effect is very much weaker, as shown by the large amounts it is necessary to employ.

DYEING: European Method

No doubt these proportions would have to be varied a little, according to the quality of the root, and the method of the washing process employed.

As to the actual dyeing process, it differs in nowise from that in vogue with madder. The mordanted calico was always introduced into the cold dye-bath, the temperature of which was then gradually raised to the boiling point in the course of 1½ hours, and the *dyeing continued for*

in morinda-root and morinda-garancine, comparative dyeing experiments *on stripe mordanted calico were made with pure morindone, from which* it appeared that the particular morinda-root examined contained the equivalent of 1 per cent morindone, 75 grms. washed morinda root (equivalent to 10 grms of the unwashed root), had a dyeing power equal to 15 grms madder root of good quality

Reds & Pinks with Alumina.

The red and pink obtained on alumina mordant are yellower than the corresponding madder colours, the chocolate presents a similar difference in tone, and hence appears fuller than a madder chocolate, while the lilac is distinctly redder

Oil prepared Calico.

to the intensity of the mordant

Wool & Silk.

On wool and silk, mordanted according to the usual methods, good chocolate-browns are obtained with chromium, orange-reds with alumina, bright orange with tin, and dark purple and black with iron mordant.

Washing Process

All the colours referred to are as fast to soap as the corresponding madder colours; their fastness to light has not yet been studied, but we shall not be surprised to find them equal the madder colours also in this respect

Dyeing power of Morinda.

Although, as already stated, *unwashed* morinda-root will not dye ordinary mordanted calico, it does dye, to a small extent, with sodium carbonate added to the dye-bath, cotton prepared with oil and alumina mordant as for Turkey-red, but even here the orange red colour produced is very weak compared with that obtained by means of the *washed* root With respect to wool and silk, however, even in the unmordanted condi-

washed and unwashed

the brightness of which

slightly acid condition

Parallel experiments

made with solutions of crude chlororubin and of pure morindine showed that the former gave a weak olive-yellow, the latter a bright-yellow colour inclining to orange or e.

It seems evident therefor

T Wardle are merely du

the root, and since they

turned red thereby, and

likely to prove useful col

of madder possesses sim

wood.

Conf. with p 2.

Simple Method.

Having then in the above-mentioned washing process found a simple and ready means of rendering the morinda root of Indian commerce a really useful dye-stuff, we compared the colouring power of the following

and of the growers of *Al*-root. (*Hummel & Perkin.*) MORINDA umbellata.

nine different samples of root supplied to us by the authorities of the Imperial Institute, London :— DYEING: European Method

1	Root, thin, Damoh,	C P	1313/92
2	" " " "		1315/92
3	" middling, Damoh,	C P.	1312/92
4	" " " "		1314/92
5	" first quality, Jhansi District,	N.-W.P	338/92
6	" middling "	"	384/92
7	" powdered "	"	349/92
8	" " "	"	290/92
9	" medium thickness, Jalaun	"	343/92

Comparative Tests.

Roughly speaking, 1℔ of Nos 1, 3, 7, containing the equivalent of 1 per cent *morindine*, and *quite equal to good madder*, had the same dyeing power as 1½℔ of Nos 5, 2, 4, and as 3℔ of Nos 6 and 9 No 8 was very poor indeed and seemed to have been spoiled All the above roots in their washed and dried condition had a more or less bright olive-yellow colour, except *No 8 which was decidedly brown*

The results of the foregoing experiments entirely corroborate those obtained by Schwartz & Koechlin as to the necessity of washing the finely ground roots with water before dyeing, and the addition of an alkaline salt, chalk, or carbonate of soda, to the dye bath in definite proportion, if good full rich reds, etc, are to be obtained We never found it necessary, however, indeed it would have been injurious, to add to the dye-bath such a large proportion of sodium carbonate as 20 per cent of the weight of the root This difference is probably owing to the different *method of washing adopted Schwartz & Koechlin seem to* have washed the root with a much larger quantity of water than we did, but for a short period only, indeed without any steeping at all apparently, whereas *we steeped the ground root in three successive quantities of water for a total period of 25 or even 50 hours*, and always with beneficial results The comparatively slight solubility of the glucoside permits indeed of considerable washing of the root without entailing any material loss of colouring power, and it seems to us best to prolong the washing a little in order to escape the *necessity of adding large percentages of chalk* or sodium carbonate to the dye bath, excessive washing, however, must of course be avoided, otherwise loss of dyeing power would ensue through loss of morindine

Washing Process. Steeping essential.

One interesting feature in connection with morinda dyeing is, that although the washed root undoubtedly contains the colouring principle still in the form of the glucoside, and which is of marked stability, it nevertheless dyes extremely well. We are unable at present to explain this, and are inclined to think that the presence of the mordant on the fabric has some influence in the matter, although we have had no time as yet to study this point."

In another part of their report Professor Hummel and Mr. Perkin deal with the subject of the *Mang-kudu* dye (**Morinda umbellata**) which is employed in Java in giving the red shades to their *batick* calicos *In India this form of al is used to a very small* extent, but at the present moment fresh enquiries are being made in the localities where the plant occurs It may, therefore, serve a useful purpose to review here very briefly the chief peculiarties of this dye that have a practical bearing In a subsequent paper on the chemistry of *mang-kudu*, these distinguished investigators have isolated the leading com-

PLATE 1
(SEE PAGES 5,7)

MORINDA CITRIFOLIA *Linn*
(The arboreous wild form)
(A) Ordinary shape of the leaves on the trees, half size

PLATE 2
(SEE PAGES 67)

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series Those of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

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This sheet and the title page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

(Veterinary Series, No. 12.)

THE

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1895—No. 12.

OXEN AND BUFFALOES.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., O. 551—94.*]

THE CATTLE AND BUFFALOES OF BAHRAICH AND KHERI:

Note by SAYYID MOHAMMAD HADI, M.R.A.C., *Assistant Director, Land Records and Agriculture, North-Western Provinces and Oudh.*

Other PAPERS that may be consulted:

Agricultural Ledger No. 19 of 1893.
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The objects of THE AGRICULTURAL LEDGER are—

(1) To provide information connected with agriculture or economic products in a *form which will admit of its ready transfer to ledgers*;

(2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in *any report or publication may be readily utilised* in all offices where ledgers are kept;

(3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein;

(4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

E. C. BUCK,

Secretary to the Government of India.

THE

AGRICULTURAL LEDGER.

1895—No. 12.

OXEN AND BUFFALOES.

[*Dictionary of Economic Products, Vol. V.,* O. 551—94.]

The CATTLE and BUFFALOES of BAHRAICH and KHERI:

Note by SAYYID MOHAMMAD HADI, M R A C, *Assistant Director, Land Records and Agriculture, North-West Provinces and Oudh.*

In February last I had the opportunity of making a tour in the district of Bahraich with a view to making enquiries into the breeds of cattle found in that district. The information collected has been classified in the following note under the heads prescribed in circular No. 45 M. issued by the Civil Veterinary Department.

1.—Suitability of the Bahraich District for cattle breeding.

Places suitable for cattle-breeding.

In the district of Bahraich, there seems to be little doubt regarding the suitability for cattle breeding of Tahsils Nánpára and Kaisarganj and the [illegible]

However, where there are pastures, they are extensive and have plenty of shade and water supply in them. There is no reason why in the event of good bulls of superior breeds, *e.g.*, those found in Kheri and Mewat, being imported and located in those parts of the district where [illegible] of breeders, [illegible] or quality of [illegible] owing fodder crops.

2.—Breeds of cattle.

Breeds of cattle.

Nánpárá enjoys some reputation for its cattle especially among the inhabitants of the southern and eastern districts of Oudh. Enquiry has, however, shown that all the cattle known in some of those districts as belonging to the Nánpárá breed are not really of that breed. The breeders and cattle dealers in the tahsils of Nánpárá import young calves from the other side of the Gogra, *viz.*, Khairigarh and Dhaurahra, and keep them with their herds or rear them for sale, till they are well grown up, when they are sold to purchasers from other districts. Many of such

bullocks are erroneously classed as cattle of the Nánpárá breed. There [illegible] ty of mention which are common

(2) The *Nanpara* breed.

Risia breed.

Risiá is really the name of a *nálá* running from north to south in a portion of the tahsil of Nánpárá and passing through the village Risiá-Grant. It is a popular belief that the quality of the *Risiá* cattle is due to the effect of water which they drink out of the *nálá*. The breed found along the side [illegible] ttered all over the [illegible], and Bahraich. [illegible] and Risiá Grant.

Nanpara breed.

[illegible]

(seldom mis-shaped), thick at the root and tapering [illegible] in the *Nánpárá* breed, though the size is not always much larger, the [illegible]

usually wider than in the indigenous breeds of Bara Banki, Lucknow, and Unao.

Risiá cows are often crossed with superior *Nánpárá* bulls of the western part of the Nánpárá Tahsil, and calves thus produced are larger in size than ordinary *Risiá* animals.

In the north-west of the Nánpárá Tahsil on the other side of the *river Sarju, the cattle, though belonging to the Nánpárá breed, are* distinctly superior in quality to those found in the vicinity of Nánpárá which is due to better and more free grazing On proceeding further [illegible]

Malwara breed of Nepal. Here we find some specimens of such a mixture of strains that it is not possible to class the animals under any distinct breed.

[illegible] as it exists now, is no longer a pure breed. A [illegible] ellence [illegible] ixture. [illegible] Kheri, [illegible] re with [illegible] able of all the breeds found in Kheri.

Desi breed.

The indigenous cattle of the Bahraich and the Kaisarganj Tahsils, which are called *Desi* or *Tehra*, are smaller in size than the *Nánpárá animals* and much poorer in quality. The best of them show in an imperfect degree some of the features of *Nánpárá* and *Risiá*, but never equal them in any respect.

Wild cattle called *Bangula* are found in the jungles of Nánpárá and Bhinga. I saw a few of them near Motipur. They are very shy and run away when they see a man coming towards them. Liberty with plenty of grazing and no work has made them fat and powerful beasts

Wild cattle.

difficult to break and less hard-working than ordinary bullocks. Attempt ... llocks. ... It is ... ld be done, at any rate to see whether such a calf would not turn out a good working bullock if reared with domestic calves.

3.—*Description of grazing.*

According to the latest returns there are altogether about 435,000 acres of grazing land in the district (the Oudh Forest excluded), ... about 28 per cent. of the total area, the largest proportion of grazing area being situated in the Parganas of Nánpárá (87,500), Hisámpur ... The total number of cattle including ... lakhs of other animals; ... nd to each 100 animals, ... reason that owners of ... nd the borders of the ... grazing is allowed on payment of a fee.

Area of grazing land.

In the Nánpárá Estate, a fee of 4 annas per head of buffaloe and 2 annas per head of cow per annum is charged from professional breeders ... on the pas- ... he nature of ... It is a little ... the tahsil of Nánpárá where there is abundance of pastures and jungle. In the Nánpárá pastures, *dub* (Cynodon Dactylon) is the commonest grass. In Charda, *janewa* grows along with *dub*, but in Bahraich and part of Nánpárá a well-known grass called *sewai* (Panicum colonum) grows ...

Grasses available.

season is over cattle are sent by breeders chiefly to Nepal where there are better natural pastures.

4.—*Stall-feeding.*

Stall-feeding.

grazing by day, but there is insufficiency ...

Cattle-food.

young calves intended for agricultural work feed them in stalls on grass, straw, and millet and maize stalks Those having a large n mber ... eight or ten, have to send t
breeders to distant pasture
ther Similarly, working
rice straw, green weeds
rubi crops have been harv
the empty fields and are given *bhusa*, while in the rainy season they are again tied and fed on cut *sewai* grass and *bhusa* *Chari* is given from the middle of October to the end of December.

Management of cattle

5—*General management of cattle*

... years of ago ... *herd, or taken* ... pregnancy ... under a shed ... The calf ... learns to eat ... the pastu e ... other which is ... nths according as the mother is *barsawal* or *dobarsi*. But some calves are sold off at the early age of 6 or 7 months in order that the cow may again become in calf quickly Cows calving every year are called *barsawal*, but a larger number calve every two years, and such cows suckle the calf for about one year to 18 months A few calve every three years and are called *tikanna piavat*, they suckle the calf up to 2½ years. An *ekbarsi* cow becomes in calf again within four months of calving, a *dobarsi* within 12 months, a *tikanna* within 2½ years Old rotten curd (kept for 10 to 15 days in open air) mixed with some salt given once a day for two or three days is said to bring a cow into heat Such curd is called *chaneth*, and its effect is said to appear in ten or twelve days The root of a creeper called *Bilrakand* is also given along with salt and is said to bring about the same result

Food available in different seasons

In the rainy season no difficulty is felt in providing fodder for cattle locally as grass grows almost everywhere The herds of cows are *therefore kept throughout the rains in the villages where the owners* dwell, and live on grazing only Plough cattle are, however, given ... In the cold ... herds, ... pasture ... Nánpárá and in the Government Forest Reserve, but most of the large herds are sent further north beyond the limits of the district into the Nepal territory where the pastures are larger in area and are covered with better and more luxuriant grass which keeps green throughout the year Cattle are also sent to the other side of the Gogra in Kheri where ... than in Bahraich ... cows sent One ... sually go with the ... sheds to live in

Grazing

while at the pastures, and also make enclosures with wooden beams and sticks in which the cattle are housed at night in order to protect them from wild animals Sometimes these enclosures are partly thatched The cattle graze on the pastures all day and are brought into the enclosure at night, but are not tied, places where herds are thus kept are called *Gaurhis*

Herds are grazed in this manner at *Gaurhis* until the end of the hot weather, and in the beginning of the rains they are taken back by owners to their respective houses where they again graze on the local grass land.

Grazing.

[illegible] by bull[illegible] ly kno[illegible] so by [illegible] rh bree[illegible] *d-nah* [illegible] in other cattle districts, for a considerable number of years, and it is therefore certain that the *Nánpárá* breed is not an altogether pure breed in itself. No attempt even seems to have been made to keep up the breed, and for this reason some of the *Nánpárá* animals are found to be far superior to others. The same remarks apply to *Risiá* also whence cows are similarly sent to *Gaurhis* and are sometimes crossed there purposely or accidentally by foreign bulls. Milk is seldom drawn from the cows [illegible] owed to the calf. Calves [illegible] used partly as fuel and [illegible]. Calves are sometimes [illegible] of the district, and from [illegible] who get them there at a [illegible] *Gaurhis* are sold on return [illegible]

Crossing.

As the livelihood of the breeders depends upon the sale of their animals, they frequently part with calves when they are very young (6 months to 1 year old). A good one-year old calf of the indigenous *Nánpárá* breed, if properly fed at a *Gaurhi*, would fetch as much as Rs18 or Rs20, while one having *Malwara* or *Padnaha* blood in it would sell for even Rs25. But generally the price of a *Nánpará* yearling calf varies from Rs12 to Rs15. In the Pargana of Charda, where the specimens of the *Nánpárá* breed are generally inferior on account of poor grazing, a calf when one year old is worth Rs6 to Rs12 only. The price of a 4-year old bullock ranges from Rs18 to Rs30 according to its size and quality and the work (plough or cart) which it is fit for. An equally old bullock born of a *Nánpárá* cow and a Malwara or Khairigarh bull is considered to be worth Rs40.

Prices of cattle.

The cows being very poor milkers are not bought by cattle dealers coming from other districts. They sell at Rs4 or Rs5 each, and are often sold in lots by one breeder to another.

Cattle which do not go to *Gaurhis* are fed on dry maize stalks and [illegible]

Fodder crops not grown

at all.

(2) Rent is largely paid in kind in Tahsils Nānpārā and Bahraich, and villages are held by *Thikadars* who do not allow cultivators to grow fodder which would be of no use to themselves if given to them as rent, while the tenants are not willing to pay the heavy rent in money for the land they might wish to keep under fodder crops or to give that quantity of grain

Cattle-food.

young calves intended for agricultural work feed them in stalls on grass, straw, and millet and *maize* stalks Those having a large number, say eight or ten, have to send them at the end of the rains with herds of large [illegible] e end of the hot wea- [illegible] cold weather when [illegible] are given After the *rabi* crops have been harvested the cattle pick up what they can get in the empty fields and are given *bhusa*, while in the rainy season they are again tied and fed on cut *sewai* grass and *bhusa* *Chari* is given from the middle of October to the end of December.

Management of cattle

5—*General management of cattle.*

[illegible] ng The calf thus gets [illegible] t learns to eat blades of [illegible] the pastu e When there is little grazing, the calf remains with the mother which is stall fed The calf is weaned at the age of 7 or 8 to 18 months according as the mother is *barsawal* or *dobarsi*. But some calves are sold off at the early age of 6 or 7 months in order that the cow may again become in calf quickly Cows calving every year are called *barsawal*, but a larger number calve every two years, and such cows suckle the calf for about one year to 18 months A few calve every three years and are called *tikanna piavat*, they suckle the calf up to 2½ years. An *ekbarsi* cow becomes in calf again within four months of calving, a *dobarsi* within 12 months, a *tikanna* within 2½ years Old rotten curd (kept for 10 to 15 days in open air) mixed with some salt given once a day for two or three days is said to bring a cow into heat Such curd is called *chaneth*, and its effect is said to appear in ten or twelve days The root of a creeper called *Bilrakand* is also given along with salt and is said to bring about the same result

Food available in different *seasons*

In the rainy season no difficulty is felt in providing fodder for cattle locally as grass grows almost everywhere The herds of cows are *therefore kept throughout the rains in the villages where the owners* dwell, and live on grazing only Plough cattle are, however, given some cut grass and green maize stalks at night in addition In the cold weather when local grass begins to fall short the owners of large herds, chiefly *Ahirs, Ghosis* and *Gujars*, send the herds out to regular pastures, a few of which are situated in the north and north west of Nánpárá and in the Government Forest Reserve, but most of the large herds are sent further north beyond the limits of the district into the Nepal territory where the pastures are larger in area and are covered with better and more luxuriant grass which keeps green throughout the year Cattle are also sent to the other side of the Gogra in Kheri where there are said to be more extensive and rich pastures than in Bahraich

Grazing

One or two bulls usually accompany each large herd of cows sent One to three members of the family to which a herd belongs usually go with the herd to look after it These persons erect temporary sheds to live in while at the pastures, and also make enclosures with wooden beams and sticks in which the cattle are housed at night in order to protect them from wild animals Sometimes these enclosures are partly thatched The cattle graze on the pastures all day and are brought into the enclosure at night, but are not tied, places where herds are thus kept are called *Gaurhis*

Herds are grazed in this manner at *Gaurhis* until the end of the hot weather, and in the beginning of the rains they are taken back by owners to their respective houses where they again graze on the local grass land. — Grazing.

... sometimes incidentally covered by ... culars of the latter are not fully ... breed existing in Nepal) and also ... the Dhaurahra and Khairigarh ... estimation even than the *Pad*- ... in ... re ... lf. ... d. ... far ... ws ... ely ... or accidentally by foreign ... ws ... the whole being allowed to the calf. Calves ... herds is used partly as fuel and ... *Gaurhis*. Calves are sometimes ... ll parts of the district, and from ... Oudh, who get them there at a ... at the *Gaurhis* are sold on return — Crossing.

... depends upon the sale of their animals, they frequently part with calves when they are very young (6 months to 1 year old). A good one-year old calf of the indigenous *Nánpárá* breed, if properly fed at a *Gaurhi*, would fetch as much as ₨18 or ₨20, while one having *Malwara* or *Padnaho* blood in it would sell for even ₨25. But generally the price of a *Nánpará* yearling calf varies from ₨12 to ₨15 In the Pargana of Charda, where the specimens of the *Nánpárá* breed are generally inferior on account of poor grazing, a calf when one year old is worth ₨6 to ₨12 only The price of a 4-year old bullock ranges from ₨18 to ₨30 according to its size and quality and the work (plough or cart) which it is fit for An equally old bullock born of a *Nánpárá* cow and a Malwara or Khairigarh bull is considered to be worth ₨40. — Prices of cattle.

The cows being very poor milkers are not bought by cattle dealers coming from other districts They sell at ₨4 or ₨5 each, and are often ... one breeder to another

... fed on dry maize stalks and ... e scraped grass is also given ... e stalks are not chopped, but ... efore the animals ... ers for two reasons, *viz* — — Foddercrops not grown

(1) The breeders are not good cultivators and do not possess holdings large enough to grow sufficient fodder for their large herds. Instances are not rare of breeders who do not cultivate at all

(2) Rent is largely paid in kind in Tahsils Nánpárá and Bahraich, and villages are held by *Thikadars* who do not allow cultivators to grow fodder which would be of no use to themselves if given to them as rent, while the tenants are not willing to pay the heavy rent in money for the land they might wish to keep under fodder crops or to give that quantity of grain

which according to appraisement would be due to the *Thikadars* if the land were to be ...

... One bigha of a good crop of *jo var* is considered sufficient to feed two pairs of bullocks for one month

6 —*Determination of age of animals*

Determination of age

People tell the age of bullocks by examining their teeth Calves are said to shed the middle pair of their temporary teeth when 3 years old, and after every 6 to 9 months, one pair falls out and is replaced by a permanent pair until the animal gets all such teeth at the age of 5 to 6 years Some get all their permanent teeth before they are five Bullocks of the latter class are called *Bharakdata* or *Bhasakdata* An animal with no permanent teeth is called *Udant* with two permanent teeth it is called *Dodata*, with four such teeth *Chaukar*, with six *Chhakkar*, with eight *Mila hua* When the bullock is in the stage of getting the fourth or last permanent pair it is called *Ochha kant* Instead of stating the number of years, the breeders and dealers generally use the above technical terms to indicate the age of animals There is some religious objection on the part of Hindus to examine the teeth of cows The age of the cow is determined chiefly by her appearance People pretend to tell the age by the number of knots on the horns, but this is obviously an unsafe method

7 —*Uses to which cattle are put*

Uses of cattle

The ... thing, treading gra[illegible] ...npara) bullocks are ... The cows are usec[illegible]

8 —*Age at which animals are put to work.*

Age when worked

The animal is first put at work when 3 years old, and by the age of 4 it gets into regular work In course of breaking, hard work is not taken from the animal Bullocks intended for cart exclusively are not put to work until they are 4 years old, and at this age they are first used as the front pair in a 4 bullock cart, and when $5\frac{1}{2}$ to 6 years they are used as the hind pair.

9 —*Yield of milk*

Yield of milk

The average yield of milk from a cow is about $\frac{1}{2}$ seer and the highest does not exceed $1\frac{1}{2}$ seers In Parganas having poor and small pastures the highest yield of milk is said to be 1 seer This is the reason why the cows are seldom milked buffalo's milk being used generally for eating and *Ghi*-making The cow's milk in the Terai or villages situated in or about the forest is considered unwholesome

Cattle market

Cattle-markets.

The cattle-markets in the district are—

(1) Gandara, Pargana Hisampur.
(2) Fakhrpur, „ Fakhrpur
(3) Mahsi „ Fakhrpur.

I attended the first two of these markets personally Animals are brought there for sale from various parts of the district and also from Kha rigarh and Dhaurahra in Kheri

The following is a statement showing the sale of cattle at each market The figures were obtained through the Tahsildar of Kaisarganj —

Serial No	Pargana.	Name of village.	Name of the proprietor of the village	Number of cattle sold	Price	Remarks
1	2	3	4	5	6	7
					R a p	
1	Hisampur .	Bazar Gandara .	Sheikh Samsam Ali	1 999	18 903 4 0	The figures in column 5 have been taken from the registers kept by a Muharrir of the estate and represent the number of cattle sold from 1st February 1894 to 31st December 1894 The price of 957 cattle could not be ascertained as papers relating to their sale are said to have been destroyed by fire, and the figures in column 6 therefore represent the price of 1,042 cattle only.
2	Fakhrpur .	Bazar Fakhrpur .	Musammat Bhagwandai.	6 111	1,04 860 0 0	The figures in column 5 represent the number of cattle sold from the 30th of March 1894 to the 31st December 1894
3	Ditto . .	Bazar Mahsi .	Raja Jagat Jit Singh.	2,906*	47,100 0 0	* These figures are for the whole year

(2) During the rains the young stock reared at the pastures of Nepal is sold largely in the district to dealers from various quarters.

(3) There is sufficient grass at home to feed the herds

(4) The herds are kept on fallow lands reserved for *rabi* crops in order to manure the lands.

(5) The grass at Nepal pastures is considered to be unwholesome for the Kheri herds in the rainy season

(6) The herds have to be kept accustomed to crossing the river between the Nepal territory and the Kheri district in the rains.

If they are not made to swim across the river in one rainy season they ... to import ... or them. ... ng only

Common salt is given once or twice a month in the quantity of 15 seers to each 100 animals with a view to improve their appetite and prevent costiveness.

This is, however, not done in the months of December, January and February when, owing to want of luxuriance of natural fodder, it is not desirable to sharpen the appetite.

4. *Stall-feeding.*

Stall feeding.

Stall feeding is not resorted to except in the case of calves specially brought up for *raths* and *Bahli* or cows for milk.

Bhusa or *karbi* is given to such animals with oil cake in the form of "*sani*", and some concentrated dry food, such as gram, barley or maize is also given.

In Parehar calves specially fed in stalls get about one seer of cooked *Arhar-ki-dal* daily until they are one year old and afterwards they are allowed daily about one seer of wheat flour (to which a little salt is added) in the shape of balls (*loi*), besides grass and *bhusa*

Milk cows get oil-cakes, *bhusa*, gram, and bran in various quantities.

5 *General management*

General management

Cows become in calf between three and four years of age. Those belonging to the large herds (*langars*) are usually covered by the bulls kept with the herds The covering is usually so arranged that the cows mostly calve during the period in which they remain at the Nepal pastures (*Gaurhis*)

Soon after delivery, the right hind leg of the young calf is tied with a rope to a peg where the mother suckles the calf for 8 or 9 days After this period the calf gets strong enough to break the rope which it does and then goes out to the pasture with the mother The cows graze all ... at the *gaurhis* at night as men- ... together but not housed ... caught by special contri- ... by the neck in order to ... ng the cow into heat — ... bound

A remedy for barren cows is not known

A heavy weight in the form of a bell is suspended to the neck of such cows. It rings as they move along and its tinkling renders it easy for the owners to find a clue to their animals in the thick jungles. The constant suspension of this heavy weight means work for the cow which therefore loses weight, and if the barrenness be due to excess of fat it is thus got rid of.

Cows that are poor milkers do not command high prices. They are generally sold in lots at Rs4 to Rs6 per head, when the herds return from Nepal in the rains they are grazed at home on local pastures.

The plough bullocks live chiefly on grass and *bhusa* and get cut *chari* (millet) in the cold weather, if available. They are not grazed during the working period. Some cultivators of fair means give a small allowance, in that season, of mustard oil-cake to their plough bullocks.

6. Determination of age.

Breeders can tell the age of animals by looking at their teeth pretty accurately. A calf gets its first permanent pair when three years old, and after every six to nine months another pair of temporary teeth is replaced by a permanent pair. Calves acquire their teeth when between 5 and 6 years of age and are then called *milahua*. Determination of age

The age of cows is generally told by appearance.

7. Use to which cattle are put.

Fine bullocks of the *Perehar* and *Khairigarh* breeds are used chiefly for *bahli* and *rath*. Ordinary bullocks of all breeds are used in *chhakra* cart and for plough and sugar mills. Cows are used chiefly for breeding, and are seldom milked. Uses

Single bullocks are also used for loading grain, vegetables, etc.

8. When put to work.

Calves are first put to light work when three years old and get into regular work at the age of four.

9. Yield of milk.

Cows in the *Jangars* (herds grazing in Nepal) are never milked, the whole milk being allowed to the calf. The few stall-fed cows kept specially for milk yield from half to one seer per diem. It is said that milk in the Nigasan Tahsil is generally injurious to health, owing probably to the fact that cows eat *Ganja* (hemp) plants which grow abundantly with common grass. Yield of milk.

10. Cattle markets.

There is no cattle-market in the district. A fair is held at Gola Gokran Nath annually, at which prizes are awarded for good specimens of cattle, and bullocks are also sold. Cattle-market.

11. *Bulls.*

Bulls.

Brahmani or private bulls are usually kept in each herd (*langar*) and go with it to the *gaurhis* or pastures of Nepal. Breeders select good calves to serve as bulls If intended to be Brahmani bulls they

other than that of serving cows The Parehar owners are particularly careful in selecting good and pure-bred calves of the *Parehar* breed for breeding bulls, and similar care is also taken by the breeders of Majhra-Singahi. While at the Nepal pastures the breeders of these two tracts take all possible measures to prevent their cows being covered by the indigenous bulls of the *Malwara* and *Kanchanpur* breeds of Nepal which are considered inferior to their own. The breeders from Dhaurahra, on the contrary, try to get their cows covered by the bulls of the *Malwara* breed which is superior to the *Dhaurahra* The good specimens of *Dhaurahra* generally owe their elegance of appearance and quality to the mixture of *Malwara* blood

Nothing is done to prevent a bull commencing its work while it is too young, nor are old bulls excluded from the herds The free use of *Khairigarh* bulls in *Bhur* herds and *vice versâ* has been the cause of

and admitted to be superior to bulls of their own breed, are not imported into Dhaurahra nor regularly introduced in their herds while grazing in the Ilaqa of Malwara—a great draw back.

The cows that do not go to Nepal are covered mostly by the working bullocks, and the progeny, as one might suppose, is usually poor in every respect

12. *Other Remarks.*

Crossing.

(*a*) Crossing with western breeds is seldom resorted to in Kheri I met with only two bullocks which were crosses between a *Hariyana* cow and a *Khairigarh* bull They were taller and apparently stronger and more fleshy than the ordinary *Khairigarh* animals, and were said to be possessed of greater capacity for heavy work, but comparatively slow movers, and of more gentle temper. Although both animals were born of the same cow, yet in one the features of Hariyana were more prominent than those of the Khairigarh, while in the other the features of Kairigarh were more marked Such crossing ... deteriora-tion as to quickness of motion but

Castration

(*b*) Castration is more common ... n other breeds, on account of the bad temper.

Calves are castrated at the age of 4 to 5 years by pounding the spermatic cord with a piece of stone or the horn of a stag. When the operation is finished, turmeric mixed with mustard oil is applied to the testicles, and milk with a little alum is given internally. The calf gets well within a few days.

The Cattle of Kheri. (S. H. Hadi.) **AND BUFFALOES**

Diseases.

(c) *Diseases.*—The following is a statement showing the diseases commonly occurring in the district:—

Names of name of the diseases.	[illegible]	Symptoms.	Treatment adopted by the [illegible].
1. [illegible]	[illegible]	Swelling of the palate, the throat and the upper portion of the windpipe [illegible]	The only remedy used is firing with a red-hot piece of iron the swollen part round the throat.
2. [illegible]	[illegible]	Great flow of saliva from the mouth [illegible]	None.
3. [illegible]	[illegible]	[illegible] the animal [illegible]	[illegible] are frequently [illegible] a decoction of [illegible] the dhak tree [illegible] a remedy [illegible] has the effect of [illegible] on the worms, removing the [illegible]
4. [illegible]	Contagious.	[illegible] The animal [illegible]	No effective remedy is known. A large number of cattle have been carried away by the disease this year.
5. [illegible]		Contraction of one leg and consequent lameness attended with pain and inflammation.	Firing the affected part with a red-hot piece of iron.
6. [illegible]		One leg of the [illegible] great [illegible]	A cut is made with a knife in one ear of the animal. If blood comes out profusely the animal is saved.
7. [illegible]	—	The belly becomes inflated and it appears as if [illegible] wind [illegible] If the wind is not [illegible] becomes difficult and the animal dies of suffocation in a few hours.	Carminatives are administered.

Improvement of breeds.

(d) *Remarks regarding improvement of breeds in Kheri.*—It is neither necessary nor desirable to introduce foreign bulls into the district. The *Parehar* and the *Khairigarh* being the most valuable breeds deserve foremost attention. The former, although kept free from admixture of other strains, has been degenerating on account of want of sufficient number of bulls in the Parehar tract and the consequent unavoidable use in a large number of cases of the working plough or cart bullock for breeding purposes. On the other hand, the cause of gradual [illegible] districts of Oudh and can be greatly improved by introducing *Malwara* or *Khairigarh* bulls, the latter being more easy to procure.

The agencies for providing funds to procure these bulls could be found in (*a*) the Taluqdars of the district, (*b*) the District Board of Kheri, (*c*) the Municipal Boards of Lakhimpur, Gola, etc., and (*d*) the Agricultural Department.

If the Agricultural Department were to start a cattle-breeding farm, the importance and excellence of the *Parehar* breed should be sufficient to induce the Department to open it in some suitable place on the banks of the Kathna.

... too wet in the rains
... public expense.
...

provision. ... which has of late been added
... may gradually develop
... for Government to give pecu-
niary assistance to the District Officer in order to add the funds raised locally for distribution as prizes for cattle. Any encouragement given by Government or local bodies and Taluqdars to the breeders exhibiting their animals at this fair would, I have no doubt, be a step in the right direction.

Having examined the breeds of cattle in most of the districts of Oudh and the result obtained by the introduction of Hissar bulls, I can now say
with certain ... local breeds it is much better to
introduce ... of
the North- ... the
Kheri anim ... all
draught wo ... le for
the Kheri ... Kheri
bulls and the facility in procuring them are other reasons in favour of their preference.

Measurements, etc., of the Cattle of the various breeds found in the District of Kheri, Oudh.

Sex.	Age	Height at shoulders.	Height at croup	Height at elbow.	Length.	Length of horn.	Length of ear	Length of face	Breadth of forehead	Girth of chest.	Girth of abdomen.	Girth of forearm.	Girth of shank.	Length of neck.	Length of shank.	Colour of skin.	Colour of hair.	Remarks.
	Yrs.	Ft In	Ft In.	Ft In	Ft. In.	Ft In	Ft In.	Ft In	Ft. In.	Ft In	Ft. In	Ft In	Ft. In	Ft. In	Ft In			
Bullock	5	4 7	4 8	2 4	6 4	1 3½	0 10	1 9	0 9	6 4	7 5	1 3½	0 9	1 0	×	–	Black with white patches.	*Parsher.*
Do	8	4 5	4 4½	3 3	5 11	1 2	0 9½	1 10	0 9½	6 0	7 4	1 3	0 8½	1 0	×		Do.	Do.
Do	9	3 5½	3 6½	1 0	5 2	1 2	0 9	1 4	0 5½	4 8	5 9	×	×	1 6	×	–	Bluewhite	Do.
Do	12	3 9	3 8	3 5	5 0	1 8	0 8	1 5	0 6	5 4	6 5	1 0	0 7	1 2	×	–	White	Do.
Do	5	4 0	4 1	2 2	5 9	0 10	0 8	1 6	0 7	5 5	6 5	1 3	0 8	1 0	×	–	Grey	*Shar*
Do	6	4 0	4 1	2 2	5 7	0 10	0 8	1 7½	0 9	5 4	6 3	×	×	1 7	×	–	Do	Do.
Do	7	3 10	3 11	×	5 2	1 1½	0 7½	1 4	0 7	4 10	6 1	×	×	1 3	×	–	White	Cross between *Shar* and *Khairigarh.*
Do.	6	4 2	3 10	2 1	5 2	0 10	0 8	1 7	0 8	5 7	6 5	×	×	1 4	×	–	Do.	Do.
Do	3	4 5	4 4	×	5 8	0 9	0 8	1 7	0 9	5 6	6 3	×	×	1 6	×		Do	*Khairigarh.*
Do	3	4 1½	4 1½	2 1½	5 8	1 0	0 10	1 10	0 7½	5 5½	6 2	1 1	0 7½	1 8	×	–	White with dark spots	Do.
Do.	5	4 1½	4 2	2 3½	5 9	0 11	0 9	1 7	0 7½	5 1½	5 8½	1 1	×	1 6	×	–	Do	Do.
Do	6	3 10	3 11	×	4 9	1 2	0 9½	1 4	0 7	5 1	6 0	×	×	1 5	×	–	White	*[illegible]*
Do	8	3 11	3 11	×	5 8	1 3½	0 8	1 7½	0 8	5 4	6 1	×	×	1 7	×	–	Do.	Do.
Do	8	4 7	4 8	2 10	5 10	1 1	0 10	1 10	1 0	6 2	7 4	0 11½	×	2 0	×		Black	Cross between a *Hariyana* cow and a Khairigarh bull.
Do	7	4 7	4 8	2 4	5 11	0 9	1 0	1 9½	0 9½	6 4	7 7	0 9	×	0 9½	×		Brickcolour	Do
Cow (mother)	8	3 6	3 8	2 4	4 10	0 7	0 8	1 3	0 5	4 2	4 8	×	0 3½	1 7	×		White	*Dhaurahra* breed.
Calf	3	4 0	4 2	2 4	5 6	0 7	0 10	1 7	0 7	5 1	5 8	×	0 7	1 4	×	–	Do.	Do
Bullock	4	3 11	4 0	2 5	5 0	0 10	0 9	1 5½	0 8	4 0	5 0	×	0 6	1 6	×	–	Grey	Do.
Calf	2	3 10	4 0	×	×	0 6	0 9	1 6	×	×	×	×	×	1 4	×		White	Do
Bullock	4	3 11	3 10	2 4	5 10	0 8	0 8	1 7	0 8	5 4	6 8	×	0 8	1 2	×	–	Do	Do

Cross marks denote that measurement is not aval able

O. 551—94.

Buffaloes in the Districts of Bahraich and Kheri, Oudh.

Breed of buffaloes.

The breed of buffaloes commonly found in the above districts is the indigenous which is called the *desi* In the towns buffaloes are kept by *Ghosis*, *Ahirs* and *Gujars* for milking purposes and in villages for producing *ghee* The breed is, however, remarkable neither for milking qualities nor for size or elegance of appearance Buffaloes of the Panjab breeds locally called *pachhain*, which have curled horns, and speci- [illegible] *pachhain* and *desi* breeds are sometimes [illegible] r well to do *Ghosis*, but their number is [illegible] more valuable than the *desi* buffaloes The she buffaloes have usually a mild temper and the males are notorious for slow movement on which account they are not considered suitable for cart or plough work Buffaloes graze usually with the large herds of cows so common in both the districts Some buffaloes are sent for grazing to pastures in the jungles of the districts others to pastures in Nepal where they remain from October to June. They are brought back to their homes, in the rainy season, when there is no scarcity of natural pasturage.

Milk.

Buffalo milk.

The *desi* buffaloes yield up to 3 seers of milk a day (excluding the quantity taken by the calf) while the *pachhain* gives about 9 or 10 seers when newly imported from the Panjab but the effects of a foreign climate are said to reduce the yield in course of time to about 6 seers only The *pachhain* buffaloes are very liable to a disease called *Talai* which will be described further on, and they frequently die a premature death According to *Ghosis*' statements the most prominent features of a good milker are—

(a) Hind quarters heavier than the fore quarters
(b) Skin thin.
(c) Hair fine.
(d) Abdomen and udder large.

Prices

Price of buffaloes

The price of a she buffalo varies from Rs4 when 1 year old to Rs30 [illegible] *is supposed to be a fair price* [illegible] buffalo when full grown fetches [illegible] some, is considered worth Rs18 or Rs20

Feeding of milking buffaloes

Feeding of buffaloes

In the rainy season they graze on grass and at the time of milking in the morning and evening they get altogether about 4 seers of dry food consisting of wheat *bran and* oil cakes, or gram barley and wheat. In the cold weather besides grazing they are allowed about 3 seers of oil cake mixed with about 10 seers of *bhusa* in the form of *sani*

If possible about 1 seer of *gur* is allowed daily in addition to the above

In the hot weather they are given green weeds chopped finely and mixed with the *sani*. Dry buffaloes live only on grazing

Determination of age.

Determination of age

Male calves shed their first pair of temporary teeth when 2 years of age and get all their permanent teeth when 5 years old, one pair being

shed and replaced in course of each year. The age of females is generally told by the number of knots on the horn, each ring being said to denote one year. Buffaloes generally become in calf at the age of 3 years Some calve every year and are called *kuraha*, but the majority of them calve once in two years and are called *dosala* Flowers and leaves of [illegible] re given to buffaloes should [illegible] oratisimus) given internally are also said to produce the same effect.

Bulls.

Buffalo bulls.

Young calves of good constitution are selected to be brought up as breeding bulls. They are branded with hot iron and let loose Two kinds of marks are used for branding, one which is very common is called *bhawansa* and is of this shape y and the other which is called *murkaha dagh* is of a different shape as shown on the margin. It is

used only for branding exceedingly furious calves to indicate their wickedness in order that people might take care of themselves, when coming across buffalo bulls bearing such a mark. One bull is considered enough for a herd of 100 buffaloes

Male buffaloes are put to work at the age of 3 years and continue to work till 12 After that age they lose strength They are put to plough and cart labour but not freely, being used chiefly for carrying loads on their backs.

Diseases

Diseases of buffaloes.

The diseases to which buffaloes are liable are enumerated in the following table :—

Nature of disease	Particulars and symptoms	Treatment followed by breeders
Talai . . .	The disease is supposed to be [illegible]	Purgative is given according to the following [illegible] *Serpat* grass 2 lb [illegible] d into a doses and [illegible] Only dry *bhusa* is given as food and no water allowed
	Diarrhœa sets in and the excreta give off an offensive smell	Purging is brought on and the worms are expelled with the dung
Theria . .	Inflation of abdomen, stoppage of rumination, occurrence of death within 5 or 6 hours	Black pepper ½ *chhatank* mixed with 1 lb of *ghee* given internally is said to do good Bat's flesh a *tula* made into a ball with gram flour is considered a specific *Ghosis* kill bats and keep them buried underground to be used when required.
Khansa or *Khang Bari Mandgi*	Appearance of worms in the feet. High fever, bearing, bloody diarrhœa	Animals are tied in a pond or on miry ground Fat of tiger is burnt near the [illegible]

Measurements, etc., of the Buffaloes of the Desi breed of Kheri, Oudh.

Sex	Age.	Height at shoulder	Height at croup.	Height at elbow	Length.	Length of horn.	Length of ear	Length of face.	Breadth of forehead	Girth at chest.	Girth at abdomen.	Girth of forearm.	Girth of shank.	Length of neck.	Length of shank	Colour of skin	Colour of hair.	Remarks.
	Yrs	Ft. In	Ft In	Ft In	Ft. In	Ft. In	Ft In	Ft. In	Ft In	Ft. In	Ft In.	Ft. In	Ft In	Ft In	Ft In			
Female .	7	3 10	3 9½	2 0	5 10	1 8½	0 8	1 8	0 10	5 11	6 9		0 8½	1 6½			Dark	
Male . .	12	4 1	3 11	2 2	5 8	1 7	0 9	1 9	1 0	5 6	6 10		0 8½	1 7			Do.	

G I. C. P. O—No. 155 R & A—6 11-95—2,100.—H. R.

Measurements, etc., of the Buffaloes of the Desi breed of Kheri, Oudh

Sex	Age	Height at shoulder	Height at croup	Height at elbow	Length	Length of horn	Length of ear	Length of face.	Breadth of forehead	Girth at chest	Girth at abdomen	Girth of forearm.	Girth of shank	Length of neck	Length of shank	Colour of skin	Colour of hair	Remarks
	Yrs	Ft. In	Ft In	Ft In	Ft. In	Ft In	Ft In	Ft. In	Ft In	Ft In	Ft In	Ft. In	Ft In	Ft In	Ft In			
Female	7	3 10	3 9½	2 0	5 10	1 8½	0 8	1 8	0 10	5 11	6 9		0 8½	1 6½			Dark	
Male	11	4 1	3 11	2 2	5 8	1 7	0 9	1 9	1 0	5 6	6 10		0 8½	1 7			Do	

O. 551—94.

G I C P O—No 155 R & A—6 11-95—2 100—H R.

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(Medical & Chemical Series, No. 1.)

THE

AGRICULTURAL LEDGER.

1895—No. 13.

SACCHARUM.

(SUGAR AND SUGAR-CANE)

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. VI., Pt. II. (Chemistry of Cane and Cane-sugar), S 61—64.*]

CHEMICAL COMPOSITION OF SUGAR AND SUGAR-CANE JUICE AND OF THE RAW SUGAR.

Note by DR. J. W. LEATHER, *Agricultural Chemist to the Government of India, on results of experiments made at the Cawnpur and Poona Farms during 1894-95.*

Other PAPERS that may be consulted:

Agricultural Ledger, No. 6 of 1893.

CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895

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(1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers,

(2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,

(3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein

(4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it

E C BUCK,

Secretary to the Government of India.

(Medical and Chemical Series, No. 1.)

THE AGRICULTURAL LEDGER.

1895—No. 13.

SACCHARUM.

(SUGAR AND SUGAR-CANE)

[*Dictionary of Economic Products, Vol. VI, Pt. II. (Chemistry of Cane and Cane-sugar),* S. 61—64.]

CHEMICAL COMPOSITION OF SUGAR-CANE AND SUGAR-CANE JUICE AND OF THE RAW SUGAR OBTAINED THEREFROM.

Note by DR. J. W. LEATHER, *Agricultural Chemist to the Government of India, on results of experiments made at the Cawnpur and Poona Farms during 1894-95.*

In the following note the results of a number of analyses of sugar-cane juice and of the raw sugar are submitted and, in addition, reference will be made to the results of several analyses of the whole cane **Amount of cane-sugar in juice.**

The results obtained at these two farms are discussed in one note with the object of comparing, as far as may be, the differences which

bability, owing to the fact that at Cawnpur the crop was very much "laid" in all the plots by excessive rain

Four samples of the juice of such cane were analysed, and as will be seen, the percentage of sugar in three of them was considerably lower than that of the juice of the "standing" cane The percentage of sugar in the juice of the "standing" cane ranged from somewhat under 14 per cent up to as much as 17 5 per cent The latter is an exceptional figure and the percentage of sugar in the juice of the Cawnpur crop may be taken to have varied from 13 5 to 15 5 per cent. **Variation in sugar in Cawnpur cane.**

SACCHARUM. Chemical Composition of Sugar and

Statement I.

Percentage of Cane-sugar in the Juice of Sugar-cane

Cawnpur Sugar Cane Juice.			Poona Sugar-cane Juice					
Plot No	Treatment.	Per cent Cane-sugar	Plot No	Treatment.	Per cent Cane sugar	Plot No.	Treatment.	Per cent. Cane Sugar.
1	No manure	14 46	5	6 tons Dissolved Bones	15 86	15	55 tons Sweepings	17'37
		13 63	7	5 tons Fish manure	16 32	18	42 tons Poudrette in all these Plots. ¼ Normal water allowance.	14 53 13 17 14 29
		8 57 (laid)	8	5 tons Castor cake	16 60 16 79			
2	7 tons Cattle manure	10 51 17 56 15 57 15 63 (laid)	9	5 tons Karangi cake	15 82 16 52	19	½ Normal water allowance.	14 27 13 47 14 20
			10	2½ tons Bone meal 1 ton Saltpetre	14 48	20	Normal water allowance.	14 09 13 53 14 33
						21	Cane cut when 11 *months old.*	12 87 13 13 14 51
3	14 tons Cattle manure	14'38 9 98 (laid) 9 29 (laid)	11	3 tons Dissolved Bones 1 ton Saltpetre	17'19	22	Cane cut when 11¼ months old.	14 28 13 95
4	5 cwt. Bone Superphosphate	14 40 13 81 15 04	12	42 tons Poudrette.	17 33 16 50	23	Cane cut when 12 months old.	14 11 15'11
			13	42 tons Cattle dung	15 18 16 26			
			14	42 tons Farm-yard manure	16 10	24	Cane cut when 13 months old.	14'41 17 01

S. 61—64.

Variation in Poona cane.

The percentage of cane sugar in the juice of the Poona sugar cane crop was determined in a much larger number of samples, and in these there was very much greater uniformity than in the juice analysed at Cawnpur. The crop was in no case "laid" by rain to any extent, and these facts taken together lend a certain amount of support to the opinion expressed above that the juice of "laid" cane will contain a lower percentage of cane sugar than that of cane not so laid.

Causes of variation.

Looking over the percentages of sugar in the juice at Poona it will be observed that a sharp distinction may be drawn between the juice of plots 5 to 15 and that of plots 18 to 24, that of the former series being considerably richer in sugar than that of the latter. The juice of the plots 5 to 15 varied from 15·18 per cent. to 17·23, whereas the juice from plots 18 to 24 contained (with the exception of one sample) 12·7 to 15·11 per cent. of sugar. It is not possible to say what the exact cause of this difference was. The description of cane was alike on all these plots, as also was the method of planting. The plots 18 to 24 were manured with about 20 tons of poudrette. The manuring of the other series of plots varied in each case, but as plot No 12 was manured with the same amount of poudrette as the plots 18 to 24, it might be anticipated that, if the manuring controlled the quality of the juice, the juice of plot 12 would have contained a similar amount of sugar to that of plots 18 to 24. This is, however, not the case. It may be further mentioned in reference to the possible effect of manuring, that the amount of [illegible]

Situation of plots.

The only explanation which appears probable is that the lie of the land [illegible] water has in some way assisted the cane on the lower-lying land to grow more concentrated juice than that on the plots adjacent but higher lying. In any case the difference between the percentage of sugar in the juice of the one series of plots and in the other is very marked, and it will be of interest to observe whether a similar difference exists next year.

Analysis of raw sugar.

3. *Raw Sugar "Gur" or "Gul".*—The Statements II and III exhibit the analyses of samples of Raw Sugar from the Cawnpur and Poona Farms. In addition it was thought desirable to analyse some of the "*gur*" prepared by cultivators. They are all samples selected from North-West Provinces Districts. Samples of cultivators' *gur* prepared near [illegible] become al[illegible] raw sugar [illegible] but also t[illegible] the mineral [illegible] In addition to these items, there has been determined in several of the samples the amount of Nitrogen, the solid substances such as bits of cane and sand, and the Phosphoric Acid.

S. 61—64.

STATEMENT II.

Samples of Gur from Cawnpur

DESCRIPTION.	Cane-sugar	Glucose	Water	Ash
Cawnpur Plot I	75·45	8 57	10·92	2 54
Do " " (laid)	67 82			
Do " II	74 12	8 47	11 45	2 55
Do. " III	74 61	9 06	12 17	2 69
Do " IV	75 31	8 76	12 59	1 94
Do. " V	73 02	9 39	14 84	1 68
Do " VI	76 52	7 93	12 36	1·46
Do " VII	71 18	10 27	14 92	2 61
Do " VIII	71 88	8 47	14 87	2·18
Do " " (laid)	63 78	14 39	14 02	4 76
Do " IX	70 04	10 89	13 77	3 26
Do " " (laid)	64 51	13 54	14 79	2 69
Cawnpur "Dhaul"	79 45	7·13	5 61	3 16
Do "Dikchan"	76 63	8 13	6 55	3 33
Do "Barauka"	74 96	5·42	13 03	3 16
Do "Sarauti"	75 07	8 74	13 48	2 46
Partabgarh	70 35	8 82	7 05	3 89
Lucknow	69 64	10 15	11 95	3 23
Unao	72 28	9 88	10 09	3 03
Fyzabad	63 14	9 91	8 26	3 65

STATEMENT III.

Samples of Gur from Poona.

DESCRIPTION	Cane sugar	Glucose	Water	Ash
Plot No 4	76 41	10 92	9 85	1 40
" " 5	69 12	18 58	7 69	1 64
" " 6	75 93	10 43	9 84	1 52
" " 7	75 42	12 41	4 82	1 58
" " 8	77 65	9 88	9 77	1 44
" " 9	79 23	5 89	9 66	1 16
" " 10	74 73	10 66	10 27	1 58
" " 11	75 90	11 92	11 00	1 85
" " 12	75 56	12 25	9 86	1 33
" " 13	77 20	11 41	10 26	1 51
" " 14	77 40	11 85	7 18	1 33
" " 15	77 38	10 86	8 97	1·37
" " 18	74 71	15 71		1 43
" " 20	75 23	13 77	9 58	1 45
" " 19	71 99	14 45	10·56	1 20
" " 21	73 19	13 90	11 35	1 36
" " 22	75 85	12 56	8 57	1 28
" " 24	76 68	11 41	9 85	1 43

Cane-sugar in *gur*.

Considering now the analyses of the samples of "*gur*" prepared at the Cawnpur Farm, we find that the *gur* of plots I to IX (excluding, for the present, those relating to "laid cane") contained from 70 per cent to 76 5 per cent of cane sugar, from 7 9 to 10 9 per cent. of glucose, from

STATEMENT II.

Samples of Gur from Cawnpur

DESCRIPTION.	Cane-sugar	Glucose	Water	Ash
Cawnpur Plot I	75·45	8·57	10·92	2·54
Do " " (laid)	67·82			
Do " II	74·12	8·47	11·45	2·55
Do. " III	74·61	9·06	12·17	2·69
Do " IV	75·31	8·76	12·59	1·94
Do. " V	73·02	9·39	14·84	1·68
Do. " VI	76·52	7·93	12·36	1·46
Do " VII	71·18	10·27	14·92	2·61
Do " VIII	71·88	8·47	14·87	2·18
Do " " (laid)	63·78	14·39	14·02	4·76
Do " IX	70·04	10·89	13·77	3·26
Do. " " (laid)	64·51	13·54	14·79	2·69
Cawnpur "Dhaul"	79·45	7·13	5·61	3·16
Do "Dikchan"	70·63	8·13	6·55	3·33
Do "Barauka"	74·95	5·42	13·03	3·16
Do "Sarauti"	75·07	8·74	13·48	2·46
Partabgarh	70·35	8·82	7·05	3·89
Lucknow	69·64	10·15	11·95	3·23
Unao	72·28	9·58	10·09	3·03
Fyzabad	63·14	9·91	8·26	3·65

STATEMENT III.

Samples of Gur from Poona.

DESCRIPTION	Cane sugar	Glucose	Water	Ash
Plot No 4	76·41	10·92	9·85	1·40
" " 5	69·12	18·59	7·69	1·64
" " 6	75·93	10·43	9·84	1·52
" " 7	75·42	12·41	4·82	1·58
" " 8	77·65	9·88	9·77	1·44
" " 9	79·23	5·89	9·66	1·16
" " 10	74·73	10·66	10·27	1·58
" " 11	75·90	11·92	11·00	1·85
" " 12	75·56	12·25	9·86	1·33
" " 13	77·20	11·41	10·26	1·52
" " 14	77·40	11·95	7·18	1·33
" " 15	77·38	10·86	8·97	1·37
" " 18	74·71	15·71	.	1·42
" " 20	75·23	13·77	9·59	1·45
" " 19	71·99	14·45	10·56	1·20
" " 21	73·19	13·90	11·35	1·36
" " 22	75·85	12·56	8·57	1·23
" " 24	76·63	11·41	9·85	1·43

Cane-sugar in gur.

Considering now the analyses of the samples of "*gur*" prepared at the Cawnpur Farm, we find that the *gur* of plots I to IX (excluding, for the present, those relating to "laid cane") contained from 70 per cent to 76·5 per cent of cane sugar, from 7·9 to 10·9 per cent. of glucose, from

10 9 to 14 9 per cent of water, and from 1 46 to 3 26 per cent of mineral matter

In the case of plots I, VIII and IX, samples of the *gur* from the 'laid' cane were separate ... of cane-sugar was much ... "*gur* from the standin ... the quality of the juice ... and this year's analyses ... *variety* of cane the 'matna,' it is important to prevent it from being laid by heavy rain and wind

Cane from water-logged fields.

The figures in the second division of the statement relate to the "*gur*" of four varieties of cane grown on land adjacent to the plots I to IX but ...

Mineral matters.

find that the percentage of cane sugar is higher and the percentage of glucose and water generally lower than in the '*gur*" of the adjacent crop of 'matna' cane (plots I to IX) The proportion of mineral matters is distinctly higher No analyses of the juice of these four varieties of cane were made and it is not possible to say what its quality was, but if, with distinctly poor crops, these varieties produce a better sugar, it might be naturally expected that, if the crops were really good ones some of these varieties of cane would be more profitable to grow than the "matna' ... age

Cultivators' Gur.

... of ... ted ... to that prepared on the Farm Their worst feature was the amount of dirt bits of cane and earth which they contained This is of course readily understood when it is borne in mind that the juice at the farm was all passed through a cloth before being boiled down, and this of course the cultivators can readily do so soon as there arises any call for it in the bazaar

Cane-sugar, Poona Gur.

In the Statement III are exhibited the analyses of the various samples of raw sugar ("*gul*") selected from that prepared in the Poona experiments The percentage of cane sugar varies from 69 1 to 79 2, and in the majority of samples it was higher than that prepared at Cawnpur The glucose, however, with one exception, was distinctly higher than in the Cawnpur samples It varies from 9 88 to 18 88, one sample, however, containing only 5 89 per cent

Moisture.

The moisture, with the exception of one sample which contained only 4 8 per cent varied from 7 1 to 11 35 per cent., and was generally less than what the Cawnpur *gur* contained

Mineral matters.

The proportion of mineral matters varied from 1 16 to 1 85, which is ...

Qualities of Cawnpur and Poona Gur.

... refer briefly to one or ... Cawnpur Farm '*gur*", ... ply to the raw sugar ... will solidify on cooling ... view, the most important

Large produce at Poona.

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,, ,, 8	77 65	9 88	9 77	1·44
,, ,, 9	79 23	5 89	9 66	1 16
,, ,, 10	74 73	10 66	10 27	1 58
,, ,, 11	75 90	11 92	11 00	1 85
,, ,, 12	75 56	12 25	9 85	1 33
,, ,, 13	77 20	11 41	10 26	1 52
,, ,, 14	77 40	11 85	7 18	1 33
,, ,, 15	77 38	10 56	8 97	1 37
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Large produce at Poona.

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(Medical & Chemical Series, No. 2.)

THE

AGRICULTURAL LEDGER.

1895—No. 14.

NICOTIANA TABACUM.

(TOBACCO CULTIVATION.)

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., N. 116–128.*]

WELL WATERS AND SOILS:

Report on the composition of those which are specially suitable for Tobacco Cultivation in the Charotar, Gujerat, by DR. J. W. LEATHER, *Agricultural Chemist to the Government of India.*

CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

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E C BUCK,

Secretary to the Government of India.

(Medical & Chemical Series, No. 2.)

THE AGRICULTURAL LEDGER.

1895—No. 14.

NICOTIANA TABACUM.

(TOBACCO CULTIVATION.)

[*Dictionary of Economic Products, Vol. V*, N. 116—128]

WELL WATERS AND SOILS.

Report on the composition of those which are specially suitable for Tobacco Cultivation in the Charotar, Gujerat, by **DR. J. W. LEATHER, *Agricultural Chemist to the Government of India.***

Tour in Gujerat.

At the request of Mr. Oranne, Survey Commissioner and Director of Land Records and Agriculture, Bombay, I made a short tour of inspection of certain villages, between March 11th and 18th, 1895, in the Charotar, Gujerat, where tobacco is largely cultivated, and in some of which the well water is considered specially good for this crop

We visited the villages Mehelav and Sunav to the north of Petlad, Petlad itself and Durmuj and Bhadran to the south of Petlad. Tobacco is largely cultivated in all these villages.

Effect of well-water on tobacco.

2. The cultivators consider the water of *certain* wells to be particularly good for irrigating the tobacco crop during the cold weather, whilst the water of other wells is not considered to possess the same qualifications, and it frequently occurs, as I had occasion to notice at Petlad and at Durmuj, that they make this distinction between wells which are at very short distances from one another. At Petlad, for instance, I visited a field of tobacco in which there were two wells which were only some 200 yards apart; the water of one was used for irrigating the crop during the cold season and was described as "salty" whilst the water of the other was only used at the time of planting the crop, if the monsoon should fail, and this was designated "sweet"

But by far [illegible]

On the west

area of 9 big

cularly suitabl

nor do they

which was formerly considered the best, was nearly dry at the time of my visit, whilst three or four other wells at a distance of only a few yards contained plenty of water. The ground was somewhat uneven, but so far as I could tell, the water in all (excepting this dry one) appeared to be at about the same level. The measurements from the surface to the

NICOTIANA
Tabacum.

Well Waters

water were 50 feet, 54 feet, 54 feet, 57 feet, whilst the dry well was, curi-

about
water,
n and
ells at
Durmuj there could remain but little doubt that the water had some peculiar property.

Value of well-water confirmed by analysis.

consideration of the analyses the

good; likewise the salty water at Petlad and the two well waters marked S_1 and S_2 at Durmuj; whilst the "sweet" water at Petlad, the sample No $\frac{156}{95}$ at Durmuj and the well water at Bhadran were characterised as possessing no particular virtues for the purpose under consideration.

3 For the purposes of the chemical enquiry I selected the following samples of well water: One sample was taken of the water which is used for tobacco at *Mehelav* and at *Sunav*; *two samples were taken* from the two wells at Petlad to which I have already referred, the one being considered particularly good, whilst the other was not so characterised; three samples w from
two of the best wells was
from a well which s for
tobacco irrigation, an ll at
Bhadran, which, although used for irrigating tobacco, is not considered specially suitable.

STATEMENT I.—COMPOSITION OF WELL WATERS.

Parts per Million.

	Description.	Lime CaO.	Magnesia MgO	Potash K_2O.	Soda Na_2O.	Sulphuric Acid SO_3	Chlorine Cl.	Nitric Acid N_2O_5.	Magnesium Sulphate $MgSO_4$	Sodium Chloride NaCl	Potassium Nitrate KNO_3.
$\frac{115}{95}$	Mehelav	21	156	290	227	75	173	153	112	285	285
$\frac{142}{95}$	Sunav	31	137	433	548	134	322	247	201	530	462
$\frac{151}{95}$	Petlad "salty"	307	357	*Nil.*	1,104	371	930	841	556	1,530	1,571
$\frac{152}{95}$	Petlad "sweet"	92	72	74		10	37	11	15	61	21
$\frac{153}{95}$	Durmuj S_1	92	424	*Nil.*	6,264	663	4,097	1,948	994	8,221	3,637
$\frac{154}{95}$	Durmuj S_2	36	204	*Nil.*	2,463	302	1,612	481	453	2,652	891
$\frac{155}{95}$	Ditto	47	112	338	370	75	297	94	112	499	176
$\frac{157}{95}$	Bhadran	22	56	269		7	49	25	10	81	46
$\frac{161}{95}$	Baroda	76	80	170		*Nil.*	49	9	*Nil*	82	17
[illegible]	Miyagam "salty"	219	[illegible]	1,098	435	332	843	276	509	1,387	516
[illegible]	Miyagam "sweet"	[illegible]	164	50		31	37	15	46	61	29

Other well water. Whilst in the neighbourhood, I thought it well to obtain, for purposes of comparison, samples of well water from other places It is not only in the Charotar that some wells are said to be "salty" and others "sweet," the same circumstances are met with elsewhere and I, therefore, took samples of two well waters at Miyagam, a village 20 miles south of Baroda, the one of which was described as "salty," the other sweet, and I also took a sample of water from the Baroda College Farm well

Soils. Of soils, the following samples were selected: one each from villages Mehelav, Sunav, Petlad, Bhadran and two from Durmuj, all being from fields in which tobacco is cultivated. In addition, and for purposes of [illegible] and two from [illegible]

Composition of well-water. [illegible] s the composition of the well waters above enumerated The figures represent parts of the several ingredients per million parts of water. In the first division are placed consecutively the proportions of lime (Calcium oxide) Magnesia, Potash and Soda; the Acids, Sulphuric and Nitric, and the Chlorine. Regarding these, it is to be noted, firstly, that in six of the samples the amount of lime is not present in sufficient quantity to unite with all the Sulphuric Acid On the other hand, the amount of Magnesia is in all cases sufficient to combine with all the Sulphuric Acid, and since all [illegible] that the lime [illegible] Carbonate, [illegible] Sulphate [illegible] determined

Presence of alkali [illegible] considerable, [illegible] of the two [illegible] y considerable in some, whilst in others it is wholly absent Its presence in such large amount in one or two of the waters is more remarkable than its absence in others As a rule, if a solution of a salt of potash be poured upon a soil, the potash becomes fixed and united with silica, whilst the acid with [illegible] other base instead [illegible] the acid of [illegible] pass through [illegible] po- [illegible] , are not out of propor- [illegible]

Nitrates in well-water. [illegible] s the large amount of [illegible] a general rule, I have [illegible]

S₁ and S₂, respectively, that we find large amounts of Nitrate, whilst the others (excluding the Miyagam samples) were said to possess no such properties Knowing, as we do, the value of Nitrates as manure for the tobacco crop, it is not surprising that these waters should possess the valuable properties ascribed to them by the people

Regarding the samples from village Miyagam, which is not in the Charotar, but in the black cotton soil area, and where the waters in

question are not used for tobacco, it will be seen that in this case also the 'salty' water contains a very considerable amount of Nitric Acid, whilst the sweet water contains very little

Magnesium, etc.

In the second division of the statement are placed parts per million of Magnesium Sulphate, Sodium Chloride and Potassium Nitrate These are calculated from the amounts of Sulphuric Acid, Chlorine and Nitric Acid on the assumption that these acids are combined with the respective bases named It is probable that in the case of the Magnesium Sulphate this is so, and in the case of the Sodium Chloride there is only one water (No $\frac{161}{95}$) in which it is improbable that the assumption does not hold good

Potash

In respect to the Potassium Nitrate, however, it would not be correct to say that all the Nitric Acid in the waters exists as this salt In several potash is absent ... proportion of Nitric Acid as ... propose to do, to consider how ... villages where these "salty" ... buy Potassium ... latter not being a marketable com-

Composition of soils

...lthough the chemical analysis has thus ... *these specially useful waters I have* determined, in the samples of soils which I selected at the same time, the percentage of Potash, Phosphoric Acid and Nitrogen and these are exhibited in Statement II

STATEMENT II — COMPOSITION OF SOILS

	DESCRIPTION.	Potash K_2O per cent	Phosphoric Acid P_2O_5 per cent	Nitrogen per cent Equal to Ammonia per cent
$\frac{147}{95}$	Mel elav—tobacco land—surface 1"—11"	46	·31	034 = 040
$\frac{150}{95}$	Petlad—tobacco land—surface 1"—12"	·46	47	043 = 052
$\frac{112}{95}$	Durmuj—tobacco land—surface soil	54	22	049 = 058
$\frac{113}{95}$	Durmuj—tobacco land—surface soil	56	·38	054 = 066
$\frac{155}{95}$	Bhadran—tobacco land—surface 1"—12"	42	·58	061 = 074
$\frac{157}{95}$	Baroda Farm—field No 26, surface soil	35	10	035 = 043
$\frac{1[illegible]0}{95}$	Baroda Farm—field No 14 surface soil 1"—12"	26	04	027 = 033
$\frac{163}{95}$	Miyagam—low lying land—surface soil 1"—12"	40	·12	·031 = 037
$\frac{151}{95}$	Miyagam—good cotton land—surface soil 1"—12"	40	·14	025 = 030

The amounts of potash are in all considerable, distinctly above the average of English soils

The amounts of Phosphoric Acid are, in the case of all the "tobacco" soils very much above what is usually met with and it is only really deficient in one sample, namely, $\frac{160}{95}$

The amounts of Nitrogen, which are calculated into their equivalent of

Ammonia are, on the contrary, *very* small. This is, however, a constant feature of Indian soils, and it need only be added that, when compared with the proportion of Nitrogen in soils from other parts of India, some of these soils would appear to contain *less* than an average amount.

It is then not surprising that when one finds so much Nitrate in the irrigation water, the effect should be so marked that the people can say that one well water is better than another

Amount of nitrates put in the soil.

6. Since it would thus seem extremely probable that the particular value of these well waters is to be referred to the Nitrate which they contain, it will be interesting in conclusion to estimate how much of this salt [illegible]

[illegible]

Thus leaving out of account any Nitrate which may be contained in the other wells and allowing *only for* that *in* the water of the best wells, we may take it that 50 tons of such water as those marked "Durmuj" "S_1" and "S_2" are given to an acre of tobacco There is a very considerable [illegible]

[illegible]

of the truth The mean is 2,268 parts per million of water; 50 tons will, therefore, contain some 254lb of Nitrate of Potash

If the estimated 1,000 to 1,600 tons of the other water contain an amount of Nitrate in any way approaching that of the sample No. $\frac{155}{93}$, it will be seen that this water will contribute an amount of Nitrate about [illegible] Nitrate

[illegible] nates as [illegible] in such villages as Bhadran, where their well waters are not possessed of the peculiar features of those in villages Durmuj, Petlad, etc., whether it will not pay them to buy some saltpetre and apply it as a top dressing to their tobacco crops at the time of irrigation.

On the other hand, we may refer to the salty well at *Moyagam*. *This* well is not, I was informed, used for irrigation at all, and it might prove quite worth the while of the cultivators there to test its value for their crops. Garden produce would probably be much benefited by it.

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Entomological Series, No. 4.)

THE

AGRICULTURAL LEDGER.

1895—No. 15.

LOCUSTS.

(LOCUST CATCHERS.)

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., L. 510a.*]

AN AUTOMATIC LOCUST CATCHER:

Extract from the Russian publication, 'Selskaya Khozyălu.'

Other DICTIONARY articles that may be consulted:

Insects, *Vol. IV.*, I. 328.
Pests, *Vol. VI., Pt. I.*, P. 433, No. 16 (Locusts).
Also
The Agricultural Ledger, No. 2 of 1893.

CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

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E. C BUCK

Secretary to the Government of India

(Entomological Series, No. 4.)

THE

AGRICULTURAL LEDGER.

1895—No. 15.

LOCUSTS.

(LOCUST CATCHERS)

[*Dictionary of Economic Products, Vol V., L. 510 a.*]

AN AUTOMATIC LOCUST CATCHER

Extract from the Russian publication, 'Selskaya Khozaylu'

Of late years the approach of spring is the signal for landowners in important districts, and especially in the Russian 'Black Earth Zone,' to turn their attention not merely to the sowing of spring corn, but also to the ... 'Prūss' — The Italian locust

... ainst him under present conditions involves much labour, it is desirable that all those whom it may concern should make known amongst landowners and peasants the few known remedies derived from books or practical experience, which may serve to decrease the ravages of the above-named insect — Remedies

... e recommended is perfectly feasible in ... he re-ploughing of those particular spots ... gs are likely to be found, and these can ... examination of the actual ground on which the locusts had swarmed

It would be undoubtedly desirable to provide agriculturists of the infected districts with specimens of the locust eggs, so that they might the more readily recognise them

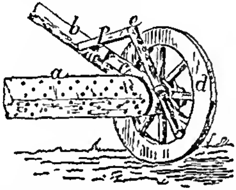
The female of the Italian locust, like most of the various varieties of grasshoppers lays her eggs, as a rule, on hard, fallow, and waste land, preferring slightly raised slopes On land only recently allowed to lie — Laying eggs.

fallow, these eggs will be found on the furrows separating two fields along the roadsides, and lying vertically on the surface

Killing young locusts.

As, however, this salutary measure may not be applied in many districts, and the locusts may hatch by myriads, the full-grown locusts will have to be attacked in summer, by driving them into ditches, burning, stamping and crushing them with rollers, catching them in curtains, and such-like operations

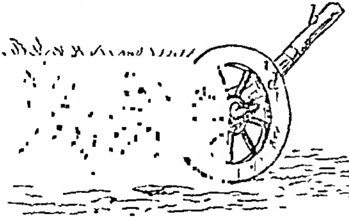
With reference to this latter phase, I wish to direct the attention of readers of this journal to a method in use in the Government of Orenburg, which has produced highly satisfactory results; this is the employment of an ordinary automatic locust catcher (Figure 1)



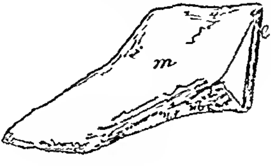
A locust catcher

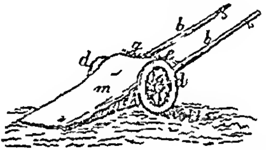
To construct the locust catcher: two wheels (*d*) are firmly fixed to the ends of a four-sided beam (*a*), and close to each wheel circular grooves are cut, to which the shafts are attached by means of iron bands in which the beam revolves like an ordinary axle. To the iron bands (*c*) and the shafts (*b*) are fixed pieces of timber (*e*), the upper ends of which are level with the tops of the wheels (*d*), and kept in a vertical position by the supports (*p*) being slightly inclined ... the horses' heads. The lower ends of these pieces project downwa...

Between the wheels and along th... series of holes are drilled with a ... one's finger, and 1½—2½ inches ap... of willow or branches of any tree wh... revolving beam (*a*) with the inserted twigs forms a broom.



Locust Catcher.	LOCUSTS
To the upper and lower extremities of the timber (e) is attached the bag (m) sewn up along the sides (Figure 3) of 14—21 feet long (according to the strength of the horses) and enough to fit in between the two wheels (d), as will be clearly understood from Figure 4.	A locust catcher.





To this simple machine one horse is harnessed, and it is dragged over the ground infected by the locust in various directions. The revolving brush thus picks up and sweeps the insects into the bag, which is very rapidly filled The latter is then emptied into a trench or hole where the locusts are either burnt or buried

G. I C P. O. No. 224 R. & A. D.—30-12-95.—2,100.

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THE

AGRICULTURAL LEDGER.

1895—No. 16.

MANURES AND MANURING.

(NIGHT-SOIL.)

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., M. 239.*]

THE DISPOSAL OF NIGHT-SOIL:

A Note by DR. J. W. LEATHER, *Agricultural Chemist to the Government of India.*

CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

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E. C. BUCK,

Secretary to the Government of India.

(Agricultural Series, No. 15.)

THE AGRICULTURAL LEDGER.

1895—No. 16.

MANURES AND MANURING.

(NIGHT-SOIL.)

[*Dictionary of Economic Products, Vol. V, M. 239.*]

THE DISPOSAL OF NIGHT-SOIL:

A Note by Dr. J. W. Leather, *Agricultural Chemist to the Government of India.*

There is perhaps no more important subject, in relation to agriculture, [illegible]

Value of night-soil.

Waste in many places

[illegible] could be [illegible] this will [illegible] of both [illegible] 119 of [illegible] I regard the spread of a good system of utilising human and household refuse, street-sweepings, etc., on the land, as a most potent factor in the improvement of Indian agriculture, and having had, among other duties, to enquire

Disposal of city-refuse

M. 239.

MANURES AND MANURING. **The Disposal of Night-soil.**

Allahabad system

It will be observed that the night-soil is spread over a much larger area than is the case in the trench system, whilst it has the advantage that it does not necessitate the after-removal of the material as is the case with poudrette.

Regarding the rapidity with which the earth becomes de-odorised, the writer can entirely substantiate what Colonel Martin says.

The only possible drawback to the method lies in the much larger area required for the disposal of the night-soil. But there can be little

thing as a premium.

The land at Allahabad which has been so treated, shows the effects of the manuring for a number of years afterwards.

Native prejudice

5. *It is doubtless the case that prejudice exists in some parts of India* against the use of night-soil. Dr. Voelcker thus refers to the point :—

use of night-soil will come into general use.

against the handling of night-soil or not,

who cart it on to the land.

That there are degrees of prejudice cannot be doubted. For instance at Allahabad the people will not allow a bullock to draw the night-soil carts and only buffaloes are employed for the work, whereas, at Nagpore, bullocks are regularly employed.

And similarly at both Poona and Nagpore the people were averse to the use of poudrette at first, but are now more than willing to pay for it. It is actually at a premium.

G. I. C. P. O.—No. 225 R. & A.—14-11-95—2,100.

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MANURES AND MANURING. **The Disposal of Night-soil.**

Allahabad system

"At the time of my visit (14th instant) grass was growing over the site of these

... ected according to the new plan.

It will be observed that the night-soil is spread over a much larger area than is the case in the trench system, whilst it has the advantage that it does not necessitate the after-removal of the material as is the

... earth becomes de-odorised, Martin says.

The only possible drawback to the method lies in the much larger

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The land at Allahabad which has been so treated, shows the effects of the manuring for a number of years afterwards.

Native prejudice

5. *It is doubtless the case that prejudice exists in some parts of India* against the use of night-soil. Dr. Voelcker thus refers to the point :—

... use of night-soil will come into general use.

Whether this prejudice is only against the *handling* of night-soil or not, the writer has as yet not satisfied himself. In the case of the method lately introduced at Allahabad the material is handled only by the scavengers, who cart it on to the land.

That there are degrees of prejudice *cannot be doubted.* *For instance* at Allahabad the people will not allow a bullock to draw the night-soil carts and only buffaloes are employed for the work, whereas, at Nagpore, bullocks are regularly employed.

And similarly at both Poona and Nagpore the people were averse to the use of poudrette at first, but are now more than *willing to pay for it.* It is actually at a premium.

The importance, however, of the systematic disposal of both sweepings and night-soil in the case of towns cannot be doubted, both from the *agricultural,* as well as *from* the sanitary, point of view.

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THE

AGRICULTURAL LEDGER.

1895—No. 18.

SHEEP.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. VI., Pt. II., S. 1332.*]

SHEEP BREEDING IN THE DECCAN:

Extract from Annual Report of the Office of Superintendent, Civil Veterinary Department, Bombay, for 1893-94, by VETERINARY-CAPTAIN J. W. A. MORGAN.

CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1896.

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E. C BUCK,

Secretary to the Government of India

(Veterinary Series, No. 13.)

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SHEEP.

[*Dictionary of Economic Products, Vol. VI., Part II.*, S. 1332.]

SHEEP BREEDING IN THE DECCAN:

Extract from Annual Report of the Office of Superintendent, Civil Veterinary Department, Bombay, for 1893-94, by VETERINARY-CAPTAIN J. W. A. MORGAN.

eeds of ewes is given below:—

Baluchistan	105 lb
Deccan	82 „
Rajputana	83 „
Merino	94 „
Siahband Rams	135 „

Baluchistan.—These Sheep have rapidly acclimatized themselves to the Deccan and do not appear to suffer from the heat, or lose condition in any way. They have bred regularly strong, healthy lambs, with a fair pro- ... The ewes are good mothers with plenty of milk. Fat ... t lambs, ... retains ... ie ewes, ... „ has a ...

Baluchistan breed.

good staple, has been condemned by experts in England as unfit for

SHEEP.

Sheep Breeding

the manufacture of high class woollen materials. Average weight of fleece, 4¾lb.

Deccan breed

Deccan.—These ewes were carefully selected by me in various parts of ... ere thoroughly representative of ... re hardy sheep, prolific breeders, ... mothers. The Siahband cross, on the Deccan ewes, is an undoubted success. Fat lambs bred on these lines, averaged, when five months old, 92lb live weight, and appear to ... and the hardiness of the mother. ... m a square compact ... eece, and practically ... ncreasing its weight ... embles the *Dumbas* ... to increase the size, ... aracter of the fleece, ... heep, in every ... no reason to ... They come ... e ewes I have ... en in India. Average weight of pure bred Deccan fleece is 1lb 3 oz. Average weight of fleece by Siahband cross, 3lb 1 oz.

Rajputana breed

... ewes were bought round about Jodhpur ... jputana sheep are supposed to be bred. They took a long time to adapt them- ... and did not thrive. The first crop of ...

make and shape from the pure bred Rajputanas. ... there is a certain amount of ... is one can judge, the violent ... been more than they could ... , and, I should say, quite un- ... of the Siahband ram is not a judicious one.

Merino breed

Merino.—Eleven pure bred Merinos were bought from the Hunter River in Queensland. They arrived in a very poor and emaciated condition, but rapidly put on flesh and bred me a crop of lambs eight months after arriving in the country. Here, again, the influence of the ram is most marked, the lamb taking on nearly all his characteristics. The fleece is completely changed from the compact close curled wool of the Merino to a soft silky straight fleece resembling a mixture of the two breeds. The head and the shoulders resemble the ram and the tail is a *Dumba's* on a modified scale. The lambs are very healthy, strong and growing rapidly. The cross, from a mutton point of view, should be a good one, but I have grave doubts, whether the admixture of two breeds both excellent in their way, is likely to be beneficial. Rams, however, bred on these lines, should make a good cross for the Deccan ewe.

Management.

I allow the flock to graze all day. They are housed at night, when they ... grass, lucerne, and chaff mixe ... e experiments are useful, in th ... of carrying a sheep far and

In the Deccan.	(*J. W. A. Morgan.*)	SHEEP.

S. 1332.

G. I. C. P. O.—No. 232 R. & A. D.—15-6-96.—2,100—W. B. G.

THE

AGRICULTURAL LEDGER.

1895—No. 19.

OXEN.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., O. 551–594.*]

BREEDS OF CATTLE IN THE MATHURA DISTRICT:

A Note by SYED MOHAMMAD HADI, M.R.A.C., *Assistant Director of Land Records and Agriculture, N.-W. P. and Oudh.*

Other PAPERS that may be consulted:

The Agricultural Ledgers, Nos. 19 of 1893; 14 of 1894; 7 of 1895; 10 of 1895; 12 of 1895.

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OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

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(1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers;

(2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept;

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BREEDS OF CATTLE IN THE MATHURA DISTRICT:

A Note by SYED MOHAMMAD HADI, M.R.A.C., *Assistant Director of Land Records and Agriculture, N.-W. P. and Oudh.*

Special reputation of Mathura cattle.

The District of Mathura enjoys a special reputation in the North-Western Provinces for its cattle. The cows of Kosi and Chhata are

breeding generally.

The following note is based upon the information I collected during the tour :—

Breeds of Cattle.

Mewat Breed.

There are two distinct breeds in this District, one of which belongs to the District proper, and the other, which is a superior breed, is a cross ... other breeds, the chief of which is the ... e natives to the tract of ... nverts called '*Mewatis.*' ... nsil, and includes part of ... the Ulwar and Bharat-

breed;
breed.

Origin of the Kosi Breed

Kosi Breed.

It is difficult to trace the exact history of this breed, for there is no proper system of breeding among the people. Any bull that can satisfy the cow, when she is in heat, and that can be had with the least possible trouble on the part of her owner, is put to her with little or no consideration of the breed he belongs to, his age, size, shape, strength, etc., or of future ill consequences arising from such a practice, which leads to a

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E. C BUCK,

Secretary to the Government of India

Measurements, etc , of the Cattle of the breeds found in the District of Matura, N.-W. P

OXEN.

Breeds of Cattle in the Mathura District.

Kosi Breed.

[illegible], so far as the enquiries reveal [illegible] evident that there is more of [illegible] breed

The following are the main distinctive features of the *Desi* and the *Kosi* breeds :—

Cows.

(*a*) *Cows* —The dewlap of the better bred (*Kosi*) cow is heavier at its origin than that of the *Desi*.

When taken in profile, it will be noticed that the forehead is more prominent The *Kosi* animal has a peculiar eye, *badami* (almond-shaped)

The hair of the *Kosi* is fine, more glossy and polished, while that of the *Desi* is rough and coarse. The tail of the better bred cow is thick at the root, and tapers from end to end, while this does not obtain in the *Desi* animal

The *Desi* cow frequently has a " pot " belly, while in the *Kosi*, it is in proportion to the size of the animal The horns too of the *Kosi* cow are always elegant in form, and in proportion to the size of the head, whereas the *Desi*, frequently, has the horns greatly developed and mis-shaped. The better bred cow has a larger udder, and the teats are further apart in the *Kosi* than in the *Desi* animal. The whole appearance of the *Kosi* denotes quality

Bullocks

(*b*) *Bullocks* —The hoofs of the mixed breed bullock are more compact, the toes are not widely separated, and are very dark and round.

Eyes are darker and more prominent, and have a game look in them. The forehead is also more prominent when seen in profile

In the better bred bullocks the superior muscles of the neck are well developed, giving greater width to the upper surface, and form a channel (*Nam*) when the neck is bent down

On the other hand, in the *Desi* bullock, the superior muscles of the neck are badly developed, making the superior portion of this region thin ; and [illegible]

Colour

[illegible] be inferior to the grey Dark-coloured [illegible] if the animal is white it should be dark on the shoulders. A red brick colour is considered the sign of a slow-mover.

The *Lakhi* (shellac-colour) is preferred to the red.

Mewat Cattle

Superiority of Mewat Cattle

These are well-built animals possessing greater strength and power of endurance than the *Kosi* cattle. They possess all the good points of the latter and usually in a higher degree. They are brought in hundreds to Kosi for sale, and are thence exported to Calcutta and other places As far as possible, people near Kosi purchase *Mewat* calves and let them loose after branding, to the memory of their ancestors. These calves in time become breeding bulls

The following measures of the cattle found in this district may be here given —

Measurements, etc., of the Cattle of the breeds found in the District of Mathura, N.-W. P.

OXEN.	Breeds of Cattle											
Measurements.	A *Measurements, etc., of the Cattle of the Breeds found*											
Sex.	Age.	Height at shoulder.	Height at croup.	Height at elbow.	Length.	Length of horn.	Length of ear.	Length of face.	Length of forehead.	Girth of chest.	Girth at abdomen.
		Ft In	Ft. In	Ft. In	Ft In	In	Ft In	Ft In.	In.	Ft In	Ft. In
Bullock . .	5	4 3	4 1½	1 2	6 5	7½	0 10	1 8	7	5 5½	6 10
Cow in calf .	12	3 8	3 8	1 1½	5 7	6	0 9	1 6	6	4 6	5 11
Cow . .	9	4 1	4 0	1 2	5 9½	3½	0 10	1 8	7	4 11	6 3
Breeding bull .	13	4 11	4 11	1 4	7 7	10	0 10	1 9½	11	6 6	7 3
Bullock . .	5	4 4½	4 6½	1 4	6 7	3	0 11	1 6½	8½	5 8½	7 0
Do. . .	3	4 10½	5 0	1 4	6 6	6	1 11	2 0	9	6 2	6 7
Do. .	5	4 11	4 9	1 4	6 6	9½	1 1	1 10½	8	6 2	7 2
Do. . .	3½	4 4	4 4	1 4	5 10½	4	0 10	1 10	8	5 6	6 0
Cow in calf .	6	4 2	4 7	1 3	7 0	6	1 0	1 9½	7	5 10	7 3
Cow . .	7	3 4	4 5	1 4	6 1½	9	0 11	1 8½	6½	5 4	6 5
Breeding bull .	7	4 4½	4 9½	1 3	7 0	5	1 0	1 10	8	6 7	7 2½

O. 551—594.

in the Mathura District. (*S. M. Hadi*)

OXEN.

in the District of Mathura (*N.-W. P.*)

Measurements.

Girth of forearm	Girth of shank.	Length of neck	Length of shank.	Colour of hair	Girth at croup	Girth of thigh	Girth of arm	Number of Plate.	Place where the animal was born.	Breed.	REMARKS
In.	In	Ft. In	Ft. In.		Ft. In	Ft In	Ft. In				
7	8¾	1 7	1 7	Dark grey	5 9	1 5	1 11	I	Jait .	*Kosi*	Calf of cow No. II.
5½	6½	1 4½	1 3	Do.	4 11	1 11	0 10	II	Do .	*Desi*	Dam of bull No. I
6½	7½	1 6½	1 5	Do.	5 2	1 3	0 11	III	Chhata	Do.	
9	10	2 4	1 11	Grey	7 6	1 9	1 6½	IV	Do	*Kosi.*	
8	9½	1 8	1 9	Do.	6 1	1 8	1 3	V	Do.	Do.	
8	10	1 8½	2 1½	Brick colour	7 1	1 6	1 4½	VI	*Firozepur.*	*Mewat.*	
9½	10½	1 5	1 10	White	6 7½	1 7	1 5½	VII	Do.	Cross between *Mewat* and *Kosi-Mewat*	
7	8½	1 2	1 8½	Do	5 4	1 4	1 2½	VIII	Do		
8	9	1 3½	1 8	Do	6 7	1 6	1 2	XII	Gurgaon	Do.	
7	8½	1 6½	1 9	Do	6 1	1 4	1 1½	XI	Kosi	*Kosi*	
9	10	1 11	1 10	Grey	6 8	1 9½	1 4	XIII	Hathua District, Mathura.	Do.	

OXEN

Breeds of Cattle

(5) The animal should be a good eater; as it is the food which ultimately produces milk

Feeding.

Cattle food for cows

(a) *Cows*—Generally no special care is taken of the cows in calf. They seldom get any food or fodder at home, but are made to depend on what they can pick up outside along with the village herd. Even good water is not supplied to them with any great care or regularity, and most of them are thus compelled to drink the water of natural pools and tanks, however dirty it may be. While milking, they receive about ten seers of *bhusa* (wheat or barley straw reduced to fine pieces by the trampling of bullocks), or failing [illegible]
they can eat. Wit[illegible]
twigs of wild plum [illegible]
Besides these things, [illegible]
tard cake, and from [illegible] the quantity of *bhusa* is reduced to four seers in case of those that are grazed during the day, and the concentrated dry food is also reduced. The cake is first dissolved in water and then given mixed with *bhusa* or *katia*. This preparation is called *sani*. Cotton seed is given after it has been well steeped in water, or boiled, the latter being considered more easily digestible and assimilable. Boiled seed is however given only in winter, being replaced in summer by an extra quantity of cake. The stall fed cows (and these are very few) receive the *sani* two or three times a day, while those that graze outside get it only once in the evening. The cows are all tied either under a thatch or inside the owner's dwelling, from July to February, with a view to protecting them from rain and cold.

Those, however, who have either a special interest in cattle or whose circumstances permit, give them at night, when they are in calf, about a basketful of *bhusa* or *katia* or dried wild plum leaves locally called *pala*, and about a pound of mustard cake in the shape of *sani*. A few days before delivery, cows are given (mostly around Kosi and in the Tahsil of Math) about 1½℔ of boiled barley mixed with ½℔ *gur*, ½℔ of mustard oil and one ounce of common salt. This mixture is intended to prevent the weakness likely to be caused by delivery, and to have a beneficial effect upon the flow of milk. Liquid food is carefully avoided for four or five days after delivery, and the cow is chiefly kept on wheat straw or wheat bran with *gur*, ginger and oil. For a month after *kila* (the period during which colostrum or *peoso* is yielded by the cow) she receives from 2 to 3℔ of boiled wheat mixed with ½ to 1 ℔ of *gur* and the milk left by the calf which is drawn. This mixture is supposed to increase the yield of milk considerably. Besides, the following are also given to cows in some cases with a view to increasing the quantity and quality of milk:—

(1) Two to two and a half seers of boiled *urd* (Phaseolus radiatus), and two pounds of crushed *juar* (Sorghum vulgare) made into gruel with about ten pounds of *matha* (churned curd).

(2) Husked *china dal* (gram Cicer arietinum) well steeped in water.

(3) *Guar* (cluster beans Cyamopsis psoralioides) or *juar* fodder cut green before the formation of seed.

(4) Grazing at about 3 A.M. (*pasar charana*), when there is dew on grass.

(5) Dried leaves or green twigs of wild plums (*pala*) chopped into small bits are said to increase the quantity of milk and the percentage of butter therein. They also impart an agreeable flavour to the milk.

(b) *Working Bullocks.*—These receive *katia* or *bhusa, ad libitum*, or dried leaves or chopped twigs of wild plums. Cake is also given in quantities varying from 1 to 2lb in the shape of *sani*. Those that can afford, give also green *juar* in addition to green grass during the rainy season. During the winter, green *sarsón* (Brassica campestris) after it has borne pods, and green *rabi* weeds are also given. Like cows, the bullocks are kept in houses during wet and cold seasons. Cattle-food for working bullocks.

(c) *Calves.*—Generally, the calves are not allowed to suck up as much milk as they require. This is almost invariably the case when, after two months or so, they have become able either to graze or eat a few blades of grass. They are seldom given any special food. Many do not send out calves along with mothers for grazing as long as cows are in milk, ... a large stock, have a special man employed to take ... om the cows. Food for calves.

... kept almost entirely on the mother's ... than half of the yield being allowed ... are given, and the allowance ... the calf learns to live on grass ... given still less ...

(d) *Bulls.*— ... are never tied ... catch them. ... and eat the standing crops ... bulls in the ... This is looked upon by the peop... several places I found the bulls so furious that it was impossible to take their measurements. ... bulls.

Barren Heifers.

People are of opinion that nothing can be done to make such animals fertile.

Determination of the Age of the Cattle.

In determining the age of bulls and bullocks it is customary to make reference to the incisor teeth, ... are eight in number and are all placed in the lower jaw. Up to t... ese are milk teeth; between two y... rst pair (middle pair) falls off and is r... between three and three years and a h... second pair is similarly replaced. In the beginning of the fifth year, the third pair falls off and its place is taken by a permanent pair. The fourth pair is replaced similarly towards the end of the fifth year, when all the permanent teeth are complete. At this stage the animal is said to be ...*lahua* (uniform) and is considered to be full grown. After this there is ... determination of the age with certainty; ... wearing, and the age is ... must be stated that some ... of the third or the fourth year. Such animals are called ... it being regarded by the Hindus as objectionable to examine the teeth of a cow, the age is mainly determined by her general appearance and the number of rings round the horn, each ring being taken to denote one calving. Bullocks are broken in the plough when three years of age, but are not often put to regular work until they are four. Determination of age.

O. 551—594.

OXEN

Breeds of Cattle

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of
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bhu

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In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series those on Forestry in the Forest Series Papers of more direct agricultural or industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

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This sheet and the title page may be removed when the subject matter is filed in its proper place according to the letter and number shown at the bottom of each page

OXEN.	Breeds of Cattle in the Mathura District.
Suggestions for improvement.	suitable. At Benares, Jaunpur, Fyzabad or C... bulls of any other ... breed.

There is, however, great need for ... Mathura itself, and the following are a f... may be carried out with a view to effectin...

(1) To begin with, ... bull of genuine *Hissar* or *Mewat* breed should be provided to each Tahsil, except Kosi, which is specially suited for breeding, and where two such bulls might be kept with advantage. These should be fed properly and kept in some central locality where cow-owners may be induced to bring their cows to be served.

The District Board may be persuaded to b... lls from ... r more ... where ... might be induced to buy two or three *Kanwaria* bulls from Bundelkhand. It would be very interesting to see the results of cross breeding with these bulls.

(3) The pastures should be manured occasionally with dung. Even ground *kunkar*, if spread or ploughed in at the rate of 2 to 3 ... neficial. ... 15 or ... l be an

(4) The cultivation of *Dub* grass (Cynodon Dactylon) and of other grasses, known to the people to be nutritious, should be extended on natural pastures.

(5) Guinea grass may be brought to the notice of cultivators, and they may be told to grow it on such patches of land as they can spare. I think the Can... , the *rajbahas*, and sell the crop to cattle o...

(6) The cu... s and carrots should be extended, and ... such fodder crops as *juár* (sorghum vulgare), Reana and Mangel Wurzel should be introduced. The Zamindars should of course be the first to start the cultivation of new fodder crops

(7) Special prizes should be given at the Bindraban Fair to persons exhibiting good specimens of cows and calves *bred in the District.*

O. 551—594.

G. I. C. P. O.—No. 231 R. & A.—13-11-95.—2,100.—H. R

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SOME OF THE COMMONER RUSTS AND MILDEWS OF INDIAN CROPS.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. III, F. 725*]

Review of the literature of certain Blights of Indian Agricultural Crops, *intended mainly to bring together, in a popular form, some of the results of the labours of the late* SURGEON MAJOR A. BARCLAY, M B., F L.S —*by* THE EDITOR.

Other DICTIONARY articles that may be consulted

Agaricus, *Vol I*, A. 589-599.
Claviceps, *Vol II*, C. 1313
Morchella, *Vol V* M. 647.
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CALCUTTA
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
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(1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers ;

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(3) To admit of the circulation in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein ;

(4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products. With this object the information published in the Ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

E. C. BUCK,

Secretary to the Government of India.

THE

AGRICULTURAL LEDGER.

1895—No. 20.

INDIAN FUNGI.

SOME OF THE COMMONER RUSTS AND MILDEWS OF INDIAN CROPS.

[*Dictionary of Economic Products,* **Agaricus,** *Vol. I,* A 589-599; **Claviceps,** *Vol II,* C. 1313 *and* **Fungi,** *Vol III,* F. 725, **Morchella,** *Vol V,* M. 647; **Truffles,** *Vol VI, Pt IV,* T. 843, *and for* **Fungoid Blights** *see the articles under Coffee, Indigo, Papaver, Rice, Sorghum, Wheat, Tea, Zea, etc Consult also the Agricultural Ledger No 4 of 1893* **(Potato Disease)** *and No 5 of 1893* **(Vine Disease)**]

Review of the literature of certain **Blights of Indian Agricultural Crops,** *intended mainly to bring together, in a popular form, some of the results of the labours of the late* SURGEON-MAJOR A BARCLAY, M B, F L S — *by* THE EDITOR.

CHAPTER I.

SOME GENERAL OBSERVATIONS ON THE STRUCTURAL PECULIARITIES OF FUNGI.

STRUCTURAL PECULIARITIES OF FUNGI

The commonly accepted opinion of a Fungus is the Mushroom or the Toadstool (*Fig 1A.*) In reality however, the toadstool might be characterised as an arborescent fungus The great family to which it belongs embraces an assemblage of plants so extensive and varied, that there are thousands of species that cannot be seen by the naked eye, but which, compared with the toadstool are smaller than the tiniest moss is to the loftiest tree In point of number of species there are known to exist in the world very nearly as many fungi as there are flowering plants It is not to be wondered at, therefore, that nearly every popular idea of a fungus disappears as untenable when the subject is studied scientifically. There are, however, certain points which persist more or less throughout the whole

FUNGI.	Commoner Rusts and Mildews

I. STRUCTURAL PECULIARITIES

assemblage. The rapidity of their growth and again of their decay are peculiarities of considerable practical importance. But their most significant feature may be said to be the fact that fungi live on decomposing vegetable or animal substances or are parasitic* on plants (and even on other fungi) or on animals (*e g*, the Entomophthoreæ on insects). The further fact that they have no green colouring matter is also to some extent characteristic. But this latter consideration may be described as a consequence of the former Fungi derive their carbonaceous food from organic materials and do not, therefore, require the aid of CHLOROPHYLL, the green colouring particles which, under the influence of the rays of the sun, enable other plants to take the carbon they require from the air,—inorganic carbon At the same time it may also be added that fungi are only very rarely aquatic plants (*e g*, Saprolegniaceæ, Chytridiaceæ, etc) But when viewed from the stand-point of morphology (that is to say, structural peculiarities) it must be admitted that some Fungi have to be regarded as Algæ that, from becoming parasitic (*Conf with p 10*) have ceased to require the aid of chlorophyll. The absence of chlorophyll is therefore, the arbitrary line that separates the Fungi from the Algæ. The majority of the Algæ are, moreover, aquatic plants

Chlorophyll.

2 The portion of the toadstool seen above ground might almost be said to correspond to the fruit of the higher plants; its object is to produce the seeds or reproductive germs The roots under or just above ground or which ramifying within organic matter are in reality both root and stem, in other words they constitute the vegetative structures of the plant and are technically known as the MYCELIUM† or *spawn* Thus the two vital conceptions of vegetable life—individual growth and reproduction of species—are fully manifested, but in the lower forms of fungi these functions gradually merge into each other (*Conf with pp 14, 27—29*). That is to say they cease to be represented by distinct organisms But in some fungi it may be assumed that only a vegetative system exists, at all events their reproductive system has not as yet been discovered In other cases the reproductive organisms are so prominent that it is with difficulty that structures can be detected that could with any degree of certainty be characterised as vegetative

Mycelium *Conf. with 1 p. 9 10, 21, 41 also Figures 1 and 3 [illegible]*

* Among the flowering plants there are many species that are known to be parasites [illegible]

† A Greek word [illegible] see Fig. 1 (A) etc.

F. 725.

FUNGI.	Commoner Rusts and Mildews

I STRUCTURAL PECULIARITIES

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Mycelium Conf with 1 P V IG, -1, 41; also figures 1 and 3 my

* *Among the F... ... there are many species that are known to be parasites ... as the ... ...*

† *A Greek w... which simply means a longing ... see Fig 1 (A) ...*

I. CLASSIFICATION.

CLASSIFICATION OF FUNGI.

The following structural peculiarities may be mentioned as more or less prevalent in certain assemblages of Fungi:—

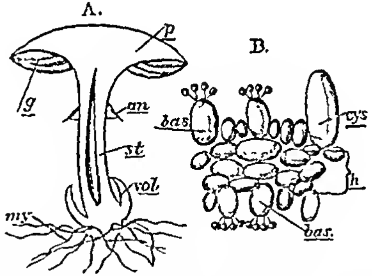
BASIDIOSPOROUS FUNGI

Basidiosporous Fungi—These occur in the SUB-CLASS MYCOMYCETES and the ALLIANCE BASIDIOMYCETES.

4. If the gills of the mushroom be examined under the microscope they will be seen to be thin plates composed of simple cells. Near the outer margin some of these cells may be observed to be more elongated than their fellows and may even be found to bear on their extremities, for the most part, four minute more or less rounded bodies. These are the spores, and the cells on which they rest are called the BASIDIA, the structure from which the Basidia take their origin is called the HYMENIUM. (*Fig. 1 B, h.*)

Basidia. *Conf. with pp. 9, 40, 100.* Hymenium.

FIG. 1.



(*A*) Vertical section of a mushroom; *p.* Pileus or head; *g.* the gills; *an.* the annulus or veil; *st.* the stipe or stalk; *vol.* the remains of the volva or wrapper; and *my.* the mycelium.

(*B*) Transverse section of one of the gills (*g*) showing at top and bottom its two lateral surfaces; *bas.* the Basidia, each bearing four spores; *cys.* Cystidia or asci; and *h.* the layer of cellular structure upon which the basidia arise—the Hymenium.

But the spores being naked, that is to say, not formed within *closed fruit vessels, Basidiosporous fungi might be viewed as in* that respect less highly organised than many of the minute species that do not form a large conspicuous toadstool-like seed-bearing

I CLASSIFICATION.

structure In the **Hymenomycetes** as for example **Agaricus** (the mushroom and toadstool) the basidia are spread over the gills, in the "fungus" of popular parlance they line the interior of a multitude of small vertical tubes packed closely together (**Polyporous** fungi), in **Hydnum**, they cover the surface of a mass of teeth or warts, and in the Clavarioid fungi (**Clavariæ**) they are distributed over the entire surface of the branched structure

Puff balls
Conf with pp 17, 40

But as manifesting a still greater departure, in the puff balls the hymenium, with its spore bearing basidia, lines the interior of a sac When young, many puff balls are in India eaten, but when ripe they burst and discharge a blinding shower of fine brown powder—the spores The puff balls form, therefore, a separate group of basidiosporous fungi known as the **Gasteromycetes**

Edible and Medicinal

In all the genera named above there are certain edible and other medicinal species, but from the standpoint of fungoid diseases it has to be added that many of them are very destructive to both living and felled timber in the forest The Porridié or Mouldy root of the vine is caused by a species of **Agaricus** (**A. mellus** and o[illegible] forms) the superficial structure of which is a harmles lookin[illegible] mushroom On badly drained vineyards the undergroun[illegible] of this species causes nearly as much injury as the much [illegible] **Phylloxera.**

The **Uredineæ** are, however, by far the most intere[illegible] blage of the Basidiosporous fungi They are par[illegible] part The mycelium lives within the intercellul[illegible] plant Certain hyphæ bear terminal [illegible] designated in consequence—Chlamydospor[illegible] kinds one, two or all three bein[illegible]

FUNGI	Commoner Rusts and Mildews

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CLASSIFICATION

Sporangia *Fig 3 a). Conf with pp 9, 17, 21*

are formed within fruit-vessels These vessels are known in their simplest manifestation as SPORANGIA, but in essential structural peculiarities the sporangium bears no external resemblance to the toadstool It is a minute sac or bladder that contains one or more spores In many cases the sporangia are so simple in their structure that they have been mistaken for naked spores Such so called spores are sometimes designated PSEUDOSPORES * at other times CONIDIA But as already stated spores are non fertilized germs that have the power of growth very much like that in tubers bulbs or cuttings, in the higher forms of plant life

Pseudospores *Fig 10 Conf with pp 3 8 9 45*

Conidia. *Conf with pp 9 13 14 21, 24 27, 33 Fig 5*

In some fungi the fruit vessels are distributed over certain portions of the mycelium (usually on the tips of its delicate branches or HYPHÆ), in other cases the sporangia are closely packed together into variously shaped bodies These are in many cases built up of what might be called perfectly formed sporangia (known as the THECÆ or ASCI *Fig 2 t*), and interspersed among these, imperfectly formed sporeless thecæ designated PARAPHYSES (*p*) These bear a resemblance to the sporeless vertical cells interspersed among the basidia (*Fig 1, B*) The spores formed within asci are sometimes spoken of as SPORIDIA—a term which in a further paragraph is also given in a more restricted signification Thecæ and paraphyses thus combine to form a *definite structure* (often called the PERITHECIUM) though strictly

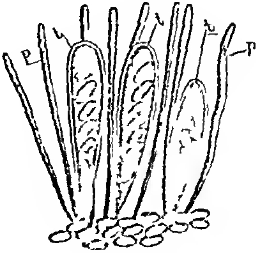
Ascus. *Conf with [illegible] 33*

Paraphyses *Conf with pp 33 48 90 100 [illegible]*

Sporidia *Conf with [illegible] 27 41 Fig 10*

Perithecium *Conf with p 8*

FIG 2



[illegible]

F. 725

I. CLASSIFICATION

speaking, that term denotes the vessel within which the thecæ and paraphyses are located. Such combined structures bear more than a superficial resemblance to aggregate fruits, such as the pine apple and the fig. The thecæ may be said to correspond to the individual fruits and the paraphyses to the bracts and floral envelopes that surround these and which are imbedded in the united structure of the aggregate fruit. Moreover in many such fungi the RECEPTACLE* (or structure on which the thecæ are inserted) might almost be said to be raised up, as in the pine-apple, thus carrying the thecæ and paraphyses external (or ECTOTHECAL as this condition is designated), or it is formed into a conceptacle with the thecæ and paraphyses lining its interior (ENDOTHECAL), very much as in the fig The thecasporous fungi have usually eight sporidia within the individual ascus or closed fruit vessel.

Receptacle

6 The truffle and the morel are well known thecasporous fungi, the former representative of the Endothecæ and the latter of the Ectothecæ. But there are many others, of minute stature, that are of even greater interest than these edible species Of this nature may be mentioned the species of **Peziza**, **Sphæria**, and **Erysiphe**. The **Peziza** are often brilliantly coloured, they are extremely interesting from a structural point of view, as may be learned from a further paragraph The **Sphæria** may be said to be an extensive genus, many of the species of which are parasitic on insects or on other fungi This latter fact has given origin to much ambiguity For example, **Sphæria** are repeatedly found parasitic on species of **Tubercularia**, so that the sporangium of the latter fungus has been taken as an additional mode of reproduction possessed by the **Sphæria**. The **Erysiphe** are Mildews that frequently do much damage to certain plants One species† is a source of constant anxiety to the hop cultivators, as it destroys the flowering property of the hops Another forms the mould on Cucurbitaceous plants—a blight very frequent in India. According to some writers **Oidium** (one of the vine diseases) is now regarded as the conidial stage of a species of **Erysiphe (E. Tuckeri)**.

One Fungus parasitic on another Conf with p. 43

7 ***Clinodium***.—But as briefly indicated above (paragraph 5), naked spores (which in some respects resemble those of the Basidiosporous fungi) and simple sporangia as also conidia (that correspond somewhat to the asci of the Thecasporous fungi) are

Clinode. Conf with pp. 17, 37, figs. 3, 9

* The term "Receptacle" is very indifferently used by various mycologists, it here practically corresponds to the Hymenium

† Podosphæra Castagnei

FUNGI.	Commoner Rusts and Mildews

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Peridium. *Conf. with pp. 39, 40, 42, 102, 107-8, 112, 114, 118, Fig. 8.*

Æcidium *Conf. with pp. 17-39, 46, 80-81, 97, Fig. 8*

Phases in Fungal Life. *Conf. with pp. 3, 11 13, 18.*

Cluster-cups. *Conf. with p. 37, Fig. 8*

Uredospores *Conf. with pp. 41 42, Fig. 9*

Pseudospores *Conf. with pp. 3, 6, 9, 45, Fig. 10.*

Teleutospores *Conf. with pp. 5, 13, 18, 34, 36-7, 43-45, 54, 96, Fig. 10*

frequently borne on the extremities of special hyphæ designated CLINODES. These spore-bearing hyphæ may be either free from each other (that is to say, dispersed over the mycelium), or they may be more or less aggregated together and sometimes even enclosed in a conceptacle or PERIDIUM corresponding to the perithecium. The definite structure formed by the aggregation of clinodes is designated the CLINODIUM. For example, in the group of fungal organisms formerly referred to the genus Æcidium (and some of the species of which are still retained in that genus), a well developed conceptacle occurs, which is even visible to the naked eye. These conceptacles are in popular language designated "Cluster-cups" In the other phases or conditions of many of these fungi (also formerly regarded as distinct genera, *viz*, Uredo and Puccinia), there is no conceptacle, but the clinodia (or pustules of PSEUDOSPORES*) occur immediately below the epidermis of the plant on which they are parasitic. In the case of wheat rust, for example, the pseudospores on reaching maturity are ejected through the ruptured *epidermis. The uredospores germinate rapidly† and give birth* to fresh uredo-pustules—thus extending the blight—but the Puccinia pseudospores,‡ which begin to form as the uredo activity declines (so far as is known and speaking generally), have usually no power of germination on *grasses (Conf. with para. 45 & 52)*, but have to be carried to a second host, where, on germination, they ultimately reproduce the æcidial condition Next year the æcidial spores give origin on grasses to a new outburst of rust or the Uredo phase of the *species. Because of their being formed later than the uredospores* and of their having the power of remaining for many months without germinating, the Puccinia pseudospores have been designated TELEUTOSPORES

Phycomycetes and Mesomycetes.

8. It is customary to speak of the Mycomycetes (—the Basidiosporous and Thecasporous Fungi of the preceding paragraphs—) as "the higher fungi", to relegate the Phycomycetes to the position of "the lower fungi", and to regard the Mesomycetes as the intermediary group With the exception of the Phycomycetes,

* [illegible]

† See the remarks p. 114 on [illegible] of uredospores

‡ Plate II, figure one shows teleutospores, figure two, a uredospore of wheat.

1\. CLASSIFICATION.

Peridium. *Conf. with pp. 39, 40, 42, 104, 107-8, 112, 114, 118, Fig 8.*

Æcidium. *Conf. with pp. 37-39, 46, 80-81, 97, Fig. 8*

Phases in Fungal Life. *Conf. with pp. 3, 11-13, 18*

Cluster-cups *Conf with p. 37, Fig 8*

Uredospores *Conf with pp 41 42, Fig. 9*

Pseudospores *Conf. with pp. 4, 6, 9, 45, Fig. 10*

Teleutospores *Conf with pp 6, 17, 18, 31, 36-7, 43-45 51, 96, Fig 10*

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* Pseudospores are spore like sporangia

† See the remarks p 114 on vitality of uredospores

‡ Plate II, figure one shows teleutospores, figure two, a uredospore of wheat.

reproduction in fungi is asexual and by means of spores or conidia Sexual reproduction, very closely analogous to that met with among certain of the Algæ, is now, however, very generally admitted as taking place among some of the lower fungi This is accomplished by the CONJUGATION and interchange of the contents of two precisely similar cells or by the formation of an OOGONIUM and its impregnation by the SPERMATOPLASM of a tubular and often pointed ANTHERIDIUM As these peculiarities will be repeatedly discussed in further paragraphs, it may serve a useful purpose to give here very briefly the chief characteristics of the three sub classes to which fungi have been referred — I PECULIARITIES IN FUNGAL LIFE.

Sub class I —MYCOMYCETES

Reproduction asexual by a limited number of spores either borne on Basidia or produced within Asci Mycelium many celled (*Conf with pp. 17 19 31-48*)

Sub-class II —MESOMYCETES

Reproduction asexual by means of spores not limited in number and often developed in Sporangia or by means of Conidia Mycelium many celled (*Conf with pp 26 30*)

Sub class III —PHYCOMYCETES

Reproduction both sexual and asexual the former either by Conjugation or by the formation of Oospores the latter by unicellular Sporangia that discharge Swarm spores Mycelium unicellular and branched (*Conf with pp 16-17 21 25*)

9 ***Life-histories.***—From what has thus been said regarding certain groups of fungi, it may have been inferred that in any effort to battle with the ravages effected by fungi it is necessary that the attack be directed against them at their weakest stage namely the infancy of the plant or, better still its hibernation But to be able to do this it becomes necessary that we should thoroughly understand the life history of each species To amplify what has already been said it may be as well therefore, to take up a few individual fungi or definite fungoid diseases and to illustrate the life histories of these more fully than has been possible in the above paragraphs where the attempt has been made to define some of the characteristics of a few of the great families or assemblages of fungi as also the principal terms employed in speaking of them Destruction of Fungal Pests.

FUNGI. | Commoner Rusts and Mildews

I.
PECULIARITIES IN FUNGAL LIFE.

CERTAIN IMPORTANT PECULIARITIES OF FUNGAL LIFE

Saprophytic
Conf with pp 14 15, 27

Parasitic
Conf with pp 2, 14-15

10 ***Saprophytic and Parasitic.***—Before proceeding further, however, there are a few terms that have still to be defined two of which denominate the very remarkable fungal condition (alluded to on page 2) of living either on dead organic matter or on living organisms Fungi that live on decomposing animal or vegetable substances are known as SAPROPHYTES, a term derived from two words meaning to live on rotten organic materials. Usually such fungi never attack living plants, they are the carrion feeders of the Vegetable Kingdom and thus discharge an important duty to the higher forms of life, by removing much that would otherwise become not only offensive but injurious. Occasionally, however, they may become parasitic, and, indeed, the range of forms between the true Saprophyte and the fully developed PARASITE is so great that it requires very considerable skill to determine the one from the other. A leaf or portion of leaf may have been killed and subsequently attacked by a saprophytic fungus. A parasitic fungus may be living on a leaf and as the result of its existence bring about the death and destruction of the leaf To the uninitiated both fungi may look remarkably alike

Host Plant
Conf with pp 5, 8 -2, 50, 55-56.

The mycelium of the parasitic fungus is pushed into the structure of the plant on which it feeds By an irony not customary in scientific terminology, this is spoken of as its "host." But let it be noted, fungi are, as a rule, remarkably accurate botanists. Wherever met with they invariably live on the same host or hosts, so that experience hardly justifies the expectation of any serious departure from this rule.

Botrytis
Conf with pp 11, 72

Saprophyte on Tea.
Conf with p. 77

The ramifications of the spawn within the tissue of the host not only drain its life sap, but very frequently effect the complete destruction of the parts within which they have uninvited taken up their abode There are, however, some fungi that regularly exist during one stage of their lives as saprophytes and become parasites during a further stage Of this nature may be mentioned the "rot" known as Botrytis (the saprophytic stage) and PezIza (the parasitic transformation)—a disease which attacks beans, clover, artichokes, roses, lilies, etc *The tea planters are familiar with the fact that if certain trees growing in the tea garden, are killed or cut down, the tea bushes die within a radius around the dead stumps*

This appears to be due to a saprophytic fungus that first lives on the decaying roots of the tree but which, when these are used up becomes a parasite on the roots of the tea and ultimately kills the bushes

I
PECULIARITIES IN FUNGAL LIFE.

But it does not follow that all parasitic fungi prove destructive to their hosts, indeed some are positively beneficial Some fungi pass through every phase of their lives as the unbidden guests on one particular species of host Others as has already been indicated (p 8), live during one phase of their lives on one host and during a second or even a third, on an altogether different host Some fungi thus pass through two or three different stages or phases of their lives, in each of which they assume an entirely different form, so that it is only by direct experiment that they can be shown to be different stages in the life cycle of one species In Gymnosporangium Cunninghamianus the fungus lives on the wild pear (Pyrus Pashia) during one phase of its life It there forms bright red patches on the leaves, but is by no means a conspicuous fungus In its further stage it attacks the Cypress (Cupressus torulosa) and becomes then conspicuous indeed In damp weather it swells into a gelatinous mass that may sometimes be seen pouring from the trees in an offensive looking stream (Conf with Dr Barclay's account in his monograph No 16 below, page 80)

Varying Phases in Fungi
Conf with 1, 5, 13, 18

The various phases of most fungi were until within recent years regarded and named as independent species—a fact that accounts very largely for the confusion that exists in the literature and terminology of the subject In other words, many fungi manifest as complete a metamorphosis as exists in the moth, with its egg, caterpillar, cocoon and perfect insect

Metamorphism
Conf with 1 12

11 *Autœcism and Heterœcism.*—The rust and mildew of wheat barley, oats sorghum and grasses generally, would very possibly not be fully understood if attention were not give to one or two other peculiarities of fungal life, which have still to be exemplified There are for example, various and often surprising methods resorted to by fungi in order to spend the interval between one year's crop and another These have been already indicated or rather implied by some of the above remarks but by way of concluding this chapter they may now be more pointedly exhibited It may have been inferred that certain fungi have their lives split up as it were into two or more widely distinct phases A fungus that lives on one host is

Hibernation
Conf with 15, 17, 18, 13

Autumn spores
Conf with 11, 17, 18, 19, 20 and

Resting spores
Conf with 1 22

I
PECULIARITIES IN FUNGAL LIFE

Dormant Mycelia. *Conf with pp 13 -5, 55 98*

Adhering spores *Conf with pp -7, 30*

Conf with Dr Cobb's Remarks, pp 4 an 54-55

called AUTŒCIOUS* It may hibernate in autumn on withered portions of its host, or produce fertilized oospores or deposit dormant mycelia within seeds or tubers or even mechanically entangle its spores on the seed coats of corn, but to complete its cycle, it does not require to spend any portion of its life upon a second host In some cases (more especially in tropical countries) autœcious species may even manifest no apparent period of repose They may extend from leaf to leaf and plant to plant, throughout the year, and in the case of some crops, it is said, even continue their existence in this manner backwards and forwards, from the cultivated state to the wild plant of their specific host

Plants that live one phase of their lives on one host and migrate in a second or a third phase to another or other hosts, are termed HETERŒCIOUS †

12 *Polymorphism.*—The polymorphism of fungi which may be spoken of as a consequence of their lives being very often split into distinct phases, may be said to be one of the most remarkable facts in the whole field of vegetable life. So completely do they change their structural peculiarities that, in the majority of instances, botanists have described the one phase under a distinct genus from that of the other And until these forms were demonstrated as only *different stages in the life history of a single species,* there was no other alternative but to treat them as independent The result has been that both the nomenclature and the classification adopted in the science of mycology have been seriously disarranged by the startling discoveries that have been made within recent years

Remarkable Feature in Plant Metamorphism *Conf with pp 14 -, 34 37, 54*

Indeed, it may be said that mycology is even now only in a transitionary condition There is one point of striking difference, however, between the metamorphism observed in certain animal organisms, or in the changes that take place from the embryonic condition to the perfect animal, and the polymorphism of fungi, *viz*, that each stage or phase in the fungal life may be viewed *as complete in itself It has its own vegetative and reproductive systems* It may, therefore, continue to grow and perpetuate itself for a very considerable period without making the change into its next higher condition As a consequence of this fungal organisms that were placed low down in the system of classification have had

* Derived from the Greek and means one dwelling
† Different dwellings.

to be promoted, as early stages in the life histories of species that had been assigned a much higher position

I PECULIARITIES IN FUNGAL LIFE

The fungi thus manifest within themselves a truly bewildering exemplification of the theory of evolution There are species that seem perfect, that is to say, possess no higher phase, but are identical with other forms now known to advance step by step to higher positions, passing as it were in each transition through groups of fungi that occupy permanently these successive stages And there are many facts that would even point (as already indicated) to the Fungi as a whole being but parasitic evolutions from the Algæ.

Phases arrested

There is, moreover, a practical aspect of these transitions that must be mentioned Under certain climatic and other influences it is now established beyond contradiction that many species possessed of the power of polymorphism and even of heterœcism may remain, to all intents and purposes, permanently in one or perhaps two of their phases, without completing their life history by passing into the third which they would do under other circumstances

Latent Mycelia *Conf with pp 11 25, 55, 98*

13 *Hibernation.*—Reproduction by means of spores may be said to manifest certain conditions of hibernation The autumn spores (teleutospores) of wheat rust for example hibernate, in Europe during the winter months (*Conf with pp 43 44*) The remaining portion of the interval between the one season s wheat crop and that succeeding, is occupied by the heterœcism of passing to the barberry A still more highly organised condition is that met with in the production of resting spores (*see page 22*) by which the fungus (as in the higher forms of plant life) spends several months in the condition of a seed

Resting as Spores

The period of rest resulting from the production of spores may, however, be regarded as only indirectly a manifestation of hibernation But there are other contrivances that may be spoken of as adaptations in the life of the creature with the direct object of hibernation For example, portions of the mycelium are often relegated to a latent state within the texture of seeds stems, roots, tubers, or other perennial structures of the host In this condition they survive during the winter months or period of non-activity In a passage from *The Agricultural Ledger* quoted below (*pp 23-25*), it will be found that this is the case with the potato-disease After having destroyed the stems and leaves of its host and extended devastation around by

FUNGI. | Commoner Rusts and Mildews

1
PECULIARITIES IN FUNGAL LIFE
Dormant Mycelia
Conf. with 11, 17, 25, 55, 58
Adhering spores.
Conf. with 12, 27, 40.

Conf. with Dr. [illegible] Remarks, 19, 40, and 54-55.

called AUTŒCIOUS.* It may hibernate in autumn on withered tions of its host, or produce fertilized oospores or depo it d mycelia within seeds or tubers or even mechanically ent spores on the seed-coats of corn, but to complete its cyc not require to spend any portion of its life upon a second some cases (more especially in tropical countries) autœc may even manifest no apparent period of repose They from leaf to leaf and plant to plant, throughout the ye r case of some crops, it is said, even continue their ex manner backwards and forwards, from the cultivated plant of their specific host.

Plants that live one phase of their lives on one in a second or a third phase to another or other HETERŒCIOUS.†

12 *Polymorphism.*—The polymorphism may be spoken of as a consequence of their lis split into distinct phases, may be said to be one able facts in the whole field of vegetable life. S change their structural peculiarities that, in the botanists have described the one phase under that of the other And until these forms we different stages in the life-history of a sin other alternative but to treat them as ind been that both the nomenclature and th the science of mycology have been startling discoveries that have been Indeed, it may be said that mycology transitionary condition There is on however, between the metamorph organisms, or in the changes that condition to the perfect animal, and t , that each stage or phase in t as complete in itself It has its systems It may, therefore co for a very considerable period next higher condition As that were placed to

Remarkable feature in Plant Metamorphism
Conf. with 11, 14, 15, 32, 37, 38

* De [illegible]
† [illegible]

II. MOULD
Sporangia Conf with pp. 6, 9, 17, 21

bodies, are the toadstools or rather puff-balls—the Sporangia (*Fig. 3 sp*) of this particular group of fungi. They burst when ripe and distribute a large number of spores. Each of these in the course of a few hours produces a new net-work of spawn, and in a day or two a coating of sporangia. The mycelium ramifies over the surface and through the substance of the decaying matter, sucking up the while the food it requires to enable it to grow and to accomplish the final object of its life—the production of a new crop of spores.

The alliance of **Zygomycetes** are, however, moulds that possess a sexual reproduction by means of the conjugation of the extremities of free hyphæ. The hard rounded reproductive seed-like body so formed is called a ZYGOSPORE. Other forms of Mould belong to the alliance of **Ascomycetes**. They have a septate mycelium and do not form sexual germs. Of this nature may be mentioned the Blue Moulds that form on jam, stale bread, leather, etc, such as **Aspergillus, Penicillium** and **Eurotium.**

II.—RUST and MILDEW on LINSEED.

RUST on LINSEED Conf with pp. 74, 84, 98, 100

19 By way of illustrating the peculiarities of a parasitic fungus which, so far as is known, lives on one host only, attention may be given to the subject of rust and mildew in Linseed. This is known to the botanist as **Melampsora Lini.** Dr Barclay's remarks regarding this genus should be consulted, as they are very instructive.

In the Central Provinces and Berar the rust usually appears about the middle of November, and by December, in bad seasons, whole expanses of country may sometimes be seen literally red with this rust.* Under these conditions the crop is utterly ruined, it fails to ripen its fruits, or does so in such a manner as to be scarcely worth the trouble and expense of being harvested. In the early part of the season this rust appears as bright orange coloured pustules, on the leaves and stems, in time these coalesce into large patches. They then look not unlike the pustules of rusted wheat (*Fig 11, page 47*), only that in linseed the fungoid patches are even more yellow than in wheat and form large coalescent blotches on the leaves, stems, and even fruits. The whole plant is thus sometimes literally covered with spores. In this stage the fungus was until very recently regarded as a species of **Lecythea.** Under the microscope these

* See Dr Barclay's remarks regarding the opinion that it communicates rust to wheat, page 98.

FUNGI. | Commoner Rusts and Mildews

II. COMMONER BLIGHTS.

CHAPTER II.

SOME OF THE COMMONER FUNGOID BLIGHTS.

Scope of this Review. *Conf. with pp. 3, 32.*

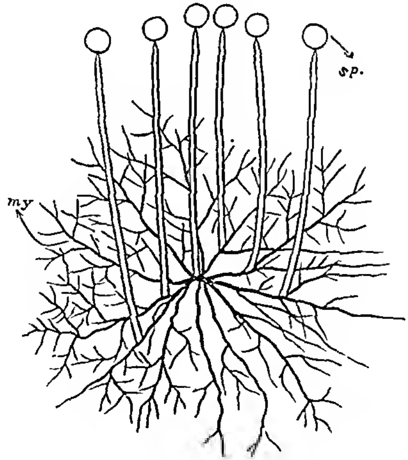
The remarks brought into this chapter are intended mainly to constitute certain nuclei around which it may in future be possible to build up fuller and more accurate accounts of the Fungoid Diseases of the Indian Crops.

MOULD.

I.—MOULD.

18. ***Mould*** (Mucor,—the ZYGOMYCETES).—The silky gray mould that forms on animal excreta, etc., will be seen to resemble a piece of velvet. Below the much-branched non-septate mycelium (*Fig. 3 my.*), corresponds to the woven fabric, and *rising* from the surface of this will be seen (if examined by a lens) a pile of erect hairs or clinodes(*p. 7*), each ending in a globular head. These globular

Fig. 3.



Mucor showing my the branched Mycelium sp. the pile of Sporangia.

F. 725.

bodies, are the toadstools or rather puff-balls—the Sporangia (*Fig 3 sp*) of this particular group of fungi They burst when ripe and distribute a large number of spores Each of these in the course of a few hours produces a new net work of spawn, and in a day or two a coating of sporangia The mycelium ramifies over the surface and through the substance of the decaying matter, sucking up the while the food it requires to enable it to grow and to accomplish the final object of its life—the production of a new crop of spores

II MOULD

Sporangia *Conf with pp. 6 9, 17, 21*

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II.—RUST and MILDEW on LINSEED

19 By way of illustrating the peculiarities of a parasitic fungus which, so far as is known, lives on one host only, attention may be given to the subject of rust and mildew in Linseed This is known to the botanist as **Melampsora Lini** Dr Barclay's remarks regarding this genus should be consulted, as they are very instructive

RUST on LINSEED *Conf with pp 72, 84, 98, 100*

In the Central Provinces and Berar the rust usually appears about the middle of November, and by December, in bad seasons, whole expanses of country may sometimes be seen literally red with this rust* Under these conditions the crop is utterly ruined, it fails to ripen its fruits, or does so in such a manner as to be scarcely worth the trouble and expense of being harvested In the early part of the season this rust appears as bright orange coloured pustules, on the leaves and stems, in time these coalesce into large patches They then look not unlike the pustules of rusted wheat (*Fig 11, page 47*), only that in linseed the fungoid patches are even more yellow than in wheat and form large coalescent blotches on the leaves, stems, and even fruits The whole plant is thus sometimes literally covered with spores In this stage the fungus was until very recently regarded as a species of **Lecythea.** Under the microscope these

* See Dr Barclay's remarks regarding the opinion that it communicates rust to wheat, page 98.

11
RUST
on
LINSEED

spores are seen to be small globose bodies They are found to germinate rapidly and thus to extend the rust on the linseed crop in an exactly similar way to the uredospores of the Puccinia on wheat One of the spores of Melampsora, in the early stage, will be seen on Plate I, figure 4 (*a*) (*page 134*), while (*b*) shows a very different looking structure that has now been identified as a band of the teleutosporous germs of this species The latter are dark coloured, are formed towards the end of the season, and may survive on the withered leaves or fragments of leaves, left on the soil, for one or two years If blown or otherwise conveyed next year to the fresh linseed crop, the winter spores (as they are called in Europe) germinate and produce once more the destructive rust This Melampsora is therefore, so far as is known, a fungus that lives the two phases of its life on one host, *viz*, linseed. Dr. Barclay (*Journal of Botany, Vol. 28, p 257*) makes the following remark regarding this disease:—"The fungus on Linum (*Alsi*) is apparently extremely common over large areas of the plains It is often so closely concurrent with rust on wheat and barley, that the uredo stage on Linum has often been supposed to be the cause of the rust on wheat This supposition, however, cannot be entertained with our present knowledge"

20 But I may here mention an observation made by me, during a recent exploration in Assam There is practically no linseed grown in that province (except a little in the Surma Valley), and thus no extensive linseed cultivation nearer perhaps than 600 or 700 miles. While in Sibsagar district and on the 7th of April, however, I came across some half a dozen plants of linseed badly affected with the Uredo pustules of Melampsora. I learned from the tea planter, with whom I was then in conversation, that he had imported from Calcutta a few maunds of linseed for the purpose of feeding his horses, and that the spot on which I picked up the diseased linseed plants was that on which his horses were regularly brought to be fed The seedlings, he remarked, had doubtless sprang from a few seeds that had fallen on the ground.

This would seem to show that either very minute particles of the leaves, bearing the teleutospores,* had been mixed with the seeds, or that in some way not *hitherto discovered by mycologists*, the seeds had carried within or upon themselves the germs that gave origin to the rust It is hardly possible to believe that some half a

* Which can retain their vitality for two or three years

dozen seedlings growing in the heart of a great tea district could have become infected by teleutospores carried by wind for hundreds of miles. In fact it may be doubted whether the teleutospores of this fungus are ever carried very far by wind, except in the form of dried and withered fragments of leaves, but these need not, of course, be larger than particles of dust. It is also possible that the linseed fruit vessels (or fragments of these) bearing teleutospores get mixed up with the seed sown for the new crop.

II. RUST on LINSEED.

Wind carried spores Conf. with pp. 61, 96, 98.

It may perhaps have been observed that in the instance mentioned, the hypothesis of wind infection is seriously upset by the dates of occurrence. The linseed rust in its uredo stage begins on the field crops of India in November and December*, the uredo rusted plants were found in Assam in April. We have, moreover, to assume that the teleutospores were wafted by breezes that blew from Bengal to Assam during January to March, before we can accept the theory of wind inoculation of the seedlings mentioned. In India, as a whole, linseed may be said to be sown in October and reaped in February and March, and during the latter months it is nearly always in its teleutosporic condition.

21. As having a further bearing on the subject of the infection of linseed, another somewhat curious case may be mentioned. In the *Agricultural Gazette* of New South Wales (*Vol. 2, p. 157*), it is stated that "of two samples of linseed, the one Calcutta and the other New Zealand, sent by the Department to Mr. Clout, of Brungle, one—the Calcutta—is reported to have become seriously affected with a red fungoid growth. A specimen of the diseased plant has been received from Mr. Clout for investigation, and the Pathologist reports that little is at present known of the disease." "The disease is caused by Melampsora Lini."

From this it might perhaps be inferred that the disease in question had not been previously found in New South Wales and that it appeared spontaneously on the crop raised from Calcutta seed. At all events I do not find mention of Melampsora Lini in any of the other elaborate and valuable papers that have appeared on the subject of the fungoid diseases of the crops of Australia.

22. ***Practical Considerations and Experiments.***—Whatever may be the scientific explanation of the observations made above, it would seem desirable that experiments should be conducted

Losses, see p. 72.

* See Dr. Barclay's observation, pp. 100, 114.

II RUST on LINSEED.

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Lancet, 109 p. 72.

* See Dr Barclay's observation, pp 100, 114

FUNGI	Commoner Rusts and Mildews

II RUST on LINSEED

Pickling seed

Conf with pp 11, 20 33

with the view of ascertaining if immunity from the disease could be secured by washing the seed in hot water or by pickling it in sulphate of copper Experimental farms might, for example, sow a plot of land with linseed, and to make sure that it would be as badly invaded with the rust as possible the plants might be inoculated by placing diseased linseed seedlings gathered from other fields, all through the plot The following year ordinary seed might then be sown, in order to ascertain the extent to which the disease seemed to survive in the field or on withered portions of last year s leaves The seed obtained from the diseased crop might, at the same time be treated in two ways One half washed thoroughly in hot water for, say, five minutes and the other half pickled in sulphate of copper These prepared batches of seed might then be sown on plots of land as remote from each other and from the old diseased field as possible, the results should be carefully recorded But these experiments in dressing or rather cleaning seed might have to be tried for a few years before definite conclusions could be drawn

Burning Diseased Stems etc

Conf with pp 21 35 36, 54, 57 58

The life-history of the fungus would seem, however, to show very conclusively that one step towards its eradication might be urged on the consideration of the cultivators with every certainty of good results, namely, that as soon as the crop is reaped and the seed separated from the twigs, *every fragment of the stems, leaves, etc, on the field and the dust on the threshing floor should be burned* If to the advantages of these precautions it can be shown that good would result from dressing next year s seed by washing in hot water, reforms that might mean a saving annually to the country of hundreds of thousands of pounds would be effected with the expenditure of only a very little extra labour on the cultivators

RUST on MUSTARD

III —RUST on MUSTARD and RAPE

23 It would seem that the rust on these crops, which in India often occasion very heavy losses to the cultivators is also a species of Melampsora This point has not however been very satisfactorily made out so that all that can be said as to its eradication is that the experiments recommended for rust in linseed might fairly well be tried in this case as well.

RUST on PULSES

IV —RUST on PULSES.

24 The Uromyces may be described as a group of parasitic

fungi very closely allied to Puccinia in which the teleutospores are reduced to a single cell and are globular bodies that differ only very slightly from their uredospores The rust of *Gram*, Cicer arietinum, and of *Khesari*, Lathyrus sativus, are species of Uromyces—Plate I, fig 5 and 6. (For another disease of pulses see p 26) II RUST on PULSES. pp 61, 84 Conf with 129

It will, however, be seen from the remarks offered on this subject by Dr. Barclay (*p* 130) that the æcidial stage of these fungi has not as yet been discovered in India His remarks are "at the same time no Æcidium on any species of Euphorbia is yet known in the plains of India, though such might be found on search" It is copious, therefore, that as in wheat rust so with that of the pulses we know at present but one half the life history of these rusts

But Uromyces occur on other crops besides the pulses, the best known perhaps being rust on Beet root

Beet Rust —Consult the Report of the Commissioner of Agriculture, United States, 1887, pp 350 353, also Jour Board Agri., London, Dec 1894 pp 203-205 For an account of other forms see Tracy and Earle, Mississippi Exp Station Bulletin No 34 of 1895, pp. 81-3

V.—MILDEW in the POTATO, VINE, POPPY, etc.

MILDEW on POTATOES

25 —Mildew (as seen in the Sub-class PHYCOMYCETES such as Peronospora, Phytophthora, and Pythium)

The sporangia of these parasites are very generally called Conidia, a name that denotes the dust like substance that will be imparted to the hand on touching the patches of velvet formed by such fungi The conidia, not the spores separate from the tufted hairs on which they are borne On germination, instead of producing the mycelium, they burst and discharge a dozen or so of minute rounded bodies (which correspond to the spores of mould), but these, under the microscope, are seen to be very active little creatures that move about with considerable rapidity, owing to the vibrations of two hairs or Cilia located at one extremity On this account they are known as Zoospores, they are almost identical in shape with the zoospores or swarm spores of Algæ In popular language the term "spores' is given to the dust particles of these parasitic fungi, but in reality, as will now be understood, they are sporangia that give birth to *zoospores* On these so called spores separating from the parent, Conidia Conf with pp 6 13 14, 24, 27, 33 Cilia Zoospore Conf with pp 14, 24.

FUNGI.	Commoner Rusts and Mildews

II RUST on LINSEED

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Conf with pp 14, 30, 33

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Burning Diseased Stems, etc

Conf with pp 21, 35, 36, 54, 57, 58

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II. RUST on PULSES. *pp. 51, 84. Conf. with 129*

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MILDEW on POTATOES.

25.—Mildew (as seen in the Sub-class PHYCOMYCETES such as Peronospora, Phytophthora, and Pythium).

Conidia. *Conf. with pp. 6, 13-14, 24, 27, 33.*

The sporangia of these parasites are very generally called CONIDIA, a name that denotes the dust-like substance that will be imparted to the hand on touching the patches of velvet formed by such fungi. The conidia, not the spores, separate from the tufted hairs on which they are borne On germination, instead of producing the mycelium, they burst and discharge a dozen or so of minute rounded bodies (which correspond to the spores of mould), but these, under the microscope, are seen to be very active little creatures that move about with considerable rapidity, owing to the vibrations of two hairs or CILIA located at one extremity. On this account they are known as ZOOSPORES; they are almost identical in shape with the zoospores or swarm-spores of Algæ In popular language the term "spores" is given to the dust particles of these parasitic fungi, but in reality, as will now be understood, they are sporangia that give birth to zoospores. On these so-called spores separating from the parent,

Cilia.

Zoospore. *Conf with pp 11, 24.*

FUNGI.	Commoner Rusts and Mildews

II
RUST on LINSEED
Pickling seed.
Conf with pp 14, 30, 33

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Conf with pp 26, 27, 30, 34, 57, 58

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II RUST on LINSEED Pickling seed *Conf with pp 14, 30, 33*

with the view of ascertaining if immunity from the disease could be secured by washing the seed in hot water or by pickling it in sulphate of copper Experimental farms might, for example, sow a plot of land with linseed, and to make sure that it would be as badly invaded with the rust as possible the plants might be inoculated by placing diseased linseed seedlings gathered from other fields, all through the plot The following year ordinary seed might then be sown, in order to ascertain the extent to which the disease seemed to survive in the field or on withered portions of last year s leaves The seed obtained from the diseased crop might, at the same time be treated in two ways One half washed thoroughly in hot water for, say, five minutes, and the other half pickled in sulphate of copper These prepared batches of seed might then be sown on plots of land as remote from each other and from the old diseased field as possible, the results should be carefully recorded But these experiments in dressing or rather cleaning seed might have to be tried for a few years before definite conclusions could be drawn

Burning Diseased Stems etc *Conf with pp 26, 37, 38, 54, 57, 68*

The life-history of the fungus would seem, however, to show very conclusively that one step towards its eradication might be urged on the consideration of the cultivators with every certainty of good results, namely, that as soon as the crop is reaped and the seed separated from the twigs *every fragment of the stems, leaves, etc, on the field and the dust, on the threshing floor should be burned* If to the advantages of these precautions it can be shown that good would result from dressing next year s seed by washing in hot water, reforms that might mean a saving annually to the country of hundreds of thousands of pounds would be effected with the expenditure of only a very little extra labour on the cultivators

RUST on MUSTARD

III —RUST on MUSTARD and RAPE

23 It would seem that the rust on these crops, which in India often occasion very heavy losses to the cultivators is also a species of **Melampsora** This point has not however, been very satisfactorily made out so that all that can be said as to its eradication is that the experiments recommended for rust in linseed might fairly well be tried in this case as well.

RUST on PULSES

IV —RUST on PULSES.

24 The **Uromyces** may be described as a group of paras tic

fungi very closely allied to Puccinia in which the teleutospores are reduced to a single cell and are globular bodies that differ only very slightly from their uredospores The rust of *Gram*, Cicer arietinum, and of *Khesari*, Lathyrus sativus, are species of Uromyces—Plate I, fig 5 and 6. (For another disease of pulses see p 26)

II RUST on PULSES pp 81, 84 Conf with 129

It will, however, be seen from the remarks offered on this subject by Dr. Barclay (p 130) that the æcidial stage of these fungi has not as yet been discovered in India His remarks are "at the same time no Æcidium on any species of Euphorbia is yet known in the plains of India, though such might be found on search" It is curious, therefore, that as in wheat rust so with that of the pulses we know at present but one half the life history of these rusts

But Uromyces occur on other crops besides the pulses, the best known perhaps being rust on Beet root

Beet Rust —Consult the Report of the Commissioner of Agriculture, United States, 1887, pp 350 353, also Jour Board Agri., London, Dec 1894, pp 203-205 For an account of other forms see Tracy and Earle, Mississippi Exp Station Bulletin No 34 of 1895, pp 81-3

V —MILDEW in the POTATO, VINE, POPPY, etc.

MILDEW on POTATOES

25 —Mildew (as seen in the Sub class PHYCOMYCETES such as Peronospora, Phytophthora, and Pythium)

The sporangia of these parasites are very generally called Conidia, a name that denotes the dust like substance that will be imparted to the hand on touching the patches of velvet formed by such fungi The conidia, not the spores, separate from the tufted hairs on which they are borne On germination, instead of producing the mycelium, they burst and discharge a dozen or so of minute rounded bodies (which correspond to the spores of mould), but these, under the microscope, are seen to be very active little creatures that move about with considerable rapidity, owing to the vibrations of two hairs or Cilia located at one extremity On this account they are known as Zoospores, they are almost identical in shape with the zoospores or swarm spores of Algæ In popular language the term "spores' is given to the dust particles of these parasitic fungi, but in reality, as will now be understood, they are sporangia that give birth to zoospores On these so-called spores separating from the parent

Conidia. Conf with pp 6 13-14, 21, 27, 33

Cilia

Zoospores Conf with pp 11, 24.

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II MILDEW on POTATOES

they may be blown by the wind, carried by insects, by water, or by other such agencies, but a certain percentage are sure to be brought into contact with plants of the kind required for their growth The conidia adhere, burst, the zoospores escape and move about over the surface of the host for a time until they find a favourable position for the production of their vegetative structures They become fixed, germinate, and the delicate thread like points of their elongating HYPHÆ (the branches of the tubular non septate mycelium) either penetrate the epidermis of the host or find an entrance by the breathing mouths (the STOMATA*) of its leaves

Hyphæ Conf with pp 1 7 11, 25, 33, 40.

Stomata Conf with pp 42 69, 76

26 ***Resting-Spores.***—Among the methods of reproduction met with in this assemblage of fungi may be mentioned the formation of OOSPORES † These might not incorrectly be described as fertilized spores or seeds They are often spoken of as *Resting-Spores* because they have the power of remaining throughout the winter months, in the soil or on the decaying portions of their former hosts A brief account of oospores will be found in the passage quoted below from *The Agricultural Ledger* (*No 4 of 1893*), but their formation can be most readily studied in the fungus Pythium—the parasite that causes the "damping off" in seedlings of cress If a dying seedling be put into a glass of water for a few days, it will be seen that some of the hyphæ form globular swellings at their extremities Under the microscope the cell contents of these swellings may be observed to separate from the cell wall and to become consolidated into a round mass It may also happen that the observer may be fortunate enough to witness another hyphæ elongate into a point approach the globular structure and finally penetrate through its cell wall The (Spermatoplasmic) contents of the penetrating hyphæ may then be seen to pass into the globular enlargement (which is designated the OOGONIUM), and shortly after the united contents may be noticed to become consolidated and surrounded by a thick tough coat On its escape from the oogonium the seed like body so formed is called the OOSPORE—a reproductive germ that in some cases may sprout even after having been in the ground for a very considerable period say, for one or two years When it germinates the egg spore may give rise at once to a new

Resting-Spore Conf with pp 21, 81 84

Oospore Conf with pp 9, 11, 27

Oogonium Conf with p 9

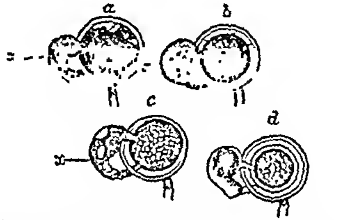
* Stoma a Greek word for a mouth or opening

† A word which may be translated "egg spores"

II. MILDEW on POTATOES

plant (*e g.* Peronospora, Pythium, etc) or it may produce swarm-spores (*e g.* Cystopus). The formation of the oospore, it will be seen, is thus closely analogous to the fertilisation of the ovule by means of pollen grains. The globularly swollen oogonium is the female, and the elongated and pointed hypha, the ANTHERIDIUM or male element in the fertilisation, although spermatozoids are not formed.

Fig. 4.



Fertilization of the Oospore in Pythium—

a Granular protoplasm in the Oogonium collecting into a ball, the penetrating hypha (*x*) or pollinodium sending in its fertilising tube;

b and c. Further stages, the contents of (*x*) having nearly all passed over into the rounded off Oospore.

d. Oospore fully fertilised and surrounded by its own cell-wall.

(After Marshall Ward.)

27. It will now be readily understood that the existence of an oospore very greatly complicates the difficulty in eradication of many fungi, but in a great number of the more dangerous blights, oospores are either not formed or have not as yet been detected. At the same time it must be admitted that there are phenomena connected with rust and mildew in wheat, for example, that would instantly meet with solution were the discovery made of the existence of some such resting or hibernating spore to that just described.

28. *Potato Disease*—Having thus briefly discussed some of the more striking peculiarities of the essential laws of fungi under consideration, it may now be as well to reprint in this place a few passages from a former issue of *The Ledger*, in which the peculiarities of the potato disease have been specially considered.

Mr. Charles Whitehead gives in a paper issued by the Board of Agriculture, London, a most instructive [illegible] and descriptive account of the

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they may be blown by the wind, carried by insects, by water, or by other such agencies, but a certain percentage are sure to be brought into contact with plants of the kind required for their growth The conidia adhere, burst, the zoospores escape and move about over the surface of the host for a time until they find a favourable position for the production of their vegetative structures They become fixed, germinate, and the delicate thread like points of their elongating HYPHÆ (the branches of the tubular non septate mycelium) either penetrate the epidermis of the host or find an entrance by the breathing mouths (the STOMATA*) of its leaves

Hyphæ Conf with pp 6, 7, 14, 26, 33, 40

Stomata Conf with pp 42, 69, 70

Resting-Spore Conf with pp 21, 61, 64

Oospore Conf with pp 1, 11, 21

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Oogonium Conf with p 9

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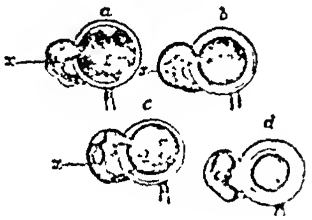
Fig. 4



FUNGI	Commoner Rusts and Mildews

V.
MILDEW
on
POTATOES

Third —The careful avoidance of diseased seed-potatoes.

Finally, it may be said the *report shows that by the observance of the second and third recommendations*, prevention might be looked for as more effective than the cure *briefly alluded to under the first consideration* "

30 Chief Fungoid Diseases of this assemblage and Publications that may be consulted—

POTATO DISEASES —Report on Experiments on Prevention and Cure of Potato Disease by Charles Whitehead, Esq, *Jour, Royal Agri Soc, England, Vol III. (3rd Series, 1892), pp 761 771*, Woburn Experiments on Potato Disease Dr J A Voelcker *l c, pp 771 783*, Rational Potato Cure, by Charles Whitehead, *l c, Vol IV, 1893 pp 406 411* Report of the Commissioner of Agriculture, United States, *1885, p 83, l c 1886, pp 121 124 l c 1887, pp 331-332, l c 1888, pp 337-339*, Potato Disease (Phytophthora infestans), *Jour Board Agri, London June 1895, pp 42 46, Prevention and Remedies l c Sept 1894 pp 43 46, l c Dec 1894, p. 202*, also another Potato Fungus (Macrosporium Solani), *pp 206 209*

TOBACCO —Peronospora Hyoscyami, *De Bary, Agricultural Gazette, New South Wales, 1891 p 618.*

ONION —Peronospora Schleideniana, *De Bary, Agricultural Gazette, New South Wales, 1891, p 616*

VINE DISEASES —Report of Commissioner of Agriculture United States, *1885, p 83*, the Downy Mildew (Peronospora viticola = Plasmopara viticola), *l c 1886 pp 56-105*, Powdery Mildew (Uncinula spiralis), *l c pp 105 109* the Black Rot (Phyllosticta Bidwellii), *l c 109 112*, Anthracnose (Sphaceloma ampelinum), *l c pp 112 120, l c 1887, pp. 323 330, l c 1888* (Septosporium), *pp 331-358, l c 1889 (Bulletin No 10)*, F LAMSON SCRIBNER, report on treatment of Downy Mildew and Black Rot; *l c 1891* (California Vine Disease) *pp 371 372 l c. 1893* (Black Rot), *pp 270-130*, Oidium (Cure), *Agricultural Gazette, New South Wales, 1890 pp 247-252* another Vine Disease (Glœosporium pestiferum), *Agricultural Gazette, New South Wales 1891, p. 348*, Anthracnosis (Black Spot on the Grape), *Agricultural Gazette, New South Wales 1891 pp 421 424*

PULSES —Peronospora Viciæ CRUCIFEROUS PLANTS—Cystopus candidus.

The observations on Pythium and Cystopus given in Bower & Vine's *Practical Instruction in Botany, Pt II, pp 133 138*, may be consulted as to the points of interest to be examined in these genera

SMUT
on
CEREALS
Conf. with IV. 11, 17

VI —BLACK SMUT in WHEAT, BARLEY, JUAR, BAJRA, INDIAN CORN, etc Diseases which with Bunt may be accepted as representing the SUB CLASS MESOMYCETES.

31 *Examples have been mentioned above of different methods* of hibernation, *manifested by various fungi* To the Indian cultivator perhaps the most serious *method* is that met with in the diseases known as Smut (Ustilago) and Bunt (Tilletia). It may, indeed be doubted whether the *annual loss* in food, to the people of this

II. SMUT on CEREALS.

country, is not quite as serious in the case of the smut and bunt, found on the staple food-grains mentioned above, as through rust in wheat, barley, and the millets. That the country should be suffering so severely from these more or less preventable diseases, is an exemplification of the difficulty that exists in inculcating new ideas and new methods on the boasted time-immemorial usages of a vast empire.

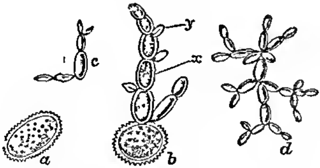
Preventable Diseases.

In the case of the diseases to which it is desired to direct attention in this chapter, hibernating spores get mechanically entangled within the seed-coats. On the germination of the seeds of *juar* or *bajra*, with entangled smut (*kandwa* or *kanki*), the fungus also germinates

Promycelium. Sporidia. *Conf. with pp. 6, 44.*

The spores in this case produce a PROMYCELIUM, the joints of which throw off very minute bodies called SPORIDIA. These emit still more minute germinal tubes which penetrate the tissue of the young sprouting seedling of wheat, barley, Indian-corn, sorghum, etc.; once inside the tissue, hyphæ are formed and elongated with the growth of the stem of the host until finally they produce their fructification within the grain. These diseases cause no very apparent injury during their elongation within the stem of the host, but once they have reached the seed, they use up entirely the material intended for the formation of the grain. It is on this account that what may have been taken

FIG. 5.



Budding. *Conf. with pp. 2, 14, 29-30, 33.*

Germination of the spores of Ustilago—

(*a*) Spore before germination greatly magnified
(*b*) Germinated and producing a promycelium (*x*) bearing sporidia (*y*).
(*c*) A sporidium separated and germinated in the form in which it enters the tissue of the sprouting corn
(*d*) Sporidia (or Conidia as they are sometimes called) living saprophytically by a process of budding—a condition that takes place if germinated in a nutrient material

F. 725.

FUNGI	Commoner Rusts and Mildews

II
ERGOT

not formed within the grain, as in bunt, but at its base, it has occupied its position, absorbed its nourishment, and carried the shrivelled, starved and dead remains of the grain as a spur like terminal formation on its own apex.

Sclerotium
Conf with
p. 14

Poisonous
Properties
Conf with
pp 28 30

40 If now attention be given to the microscopic structure of this false grain, it will be seen to be quite unlike that of bunt. It is a closely compacted mycelial tuber or SCLEROTIUM that gives no indication of the presence of spores Chemically it contains in addition to large quantities of oil (35 per cent. of its weight), a powerful poisonous principle that has the remarkable property of causing muscular contractions in various parts of the bodies of animals or men who have eaten grain mixed with it.

Medicinally this property is utilized for a specific purpose, but when eaten to any extent unintentionally, or through careless and slovenly agriculture, an alarming malady, directly traceable to this fungus, has been known to occur over large tracts of country The extremities become subject to a kind of gangrene induced through the ergotised muscular contractions, having deprived these parts of the body of their necessary supply of blood.

41 But to return to the study of the life history of the fungus The ergot sclerotia are, therefore, the hibernating structures It is a somewhat significant fact that they attain maturity at the very time the grain ripens so that the act of reaping the crop causes a large number to fall on the field where they are known to hibernate until the following season has far advanced and the cereal crops begun to set their flowering spikes

Hibernation
Conf with
pp 11, 17,
26, 53, 98

It is perhaps unnecessary to detail every stage in the further life of this fungus since the present object is to make known the existence in India of certain diseases, and, if possible, suggest remedies for them, rather than to write a scientific paper The reader would do well, therefore, to consult Prof. H. Marshall Ward's most fascinatingly written little book on the *Diseases of Plants* where he will find full particulars Suffice it to say that at the period named, wart-like structures are formed on the surface of the sclerotia These in time elongate into minute toadstools on longish stalks The globular heads of these toadstools will however, be seen under the microscope to be closely compacted (over at least their superficial layer) with multitudes of minute cysts, not unlike the spermogonia of the barberry (*Fig* 8,

Spermogonia.
Conf with
11 39,
49-50

sp) When examined even more closely these cysts will be found to be full of asci (*Fig* 2, *l*) so that each cyst might be regarded as resembling a miniature puff ball Each of the asci, it will be noted, contains from 6 to 8 long colourless thread like ascospores On reaching maturity these ascospores escape through the mouths of the cysts and carried by wind, rain, or insects, find their way to the flowering spikes of the cereal crops or wild grasses — II. ERGOT

The ascospores then germinate, produce a mycelial network over the surface of the base of the flowering spikes and finally perforate the tissue of the host by means of very minute tubes or hyphæ

42 But this is not all, the superficial hyphæ next produce, by budding, very minute conidia that are often agglutinated into largish masses by a sugary exudation The earliest symptom of the presence of ergot may, therefore, be said to be the manifestation of a sweet honey like exudation around the base of the young flowering spiklets This substance flies and other insects are very fond of, and in their greed to devour it they are made the agents of dissemination of the disease, for the conidia adhere to their feet and other parts of their bodies and are thereby carried by the insects from plant to plant It has been found that on the germination of these conidia, penetrating hyphæ are produced that differ in no essential character from those formed by the ascospores Certainly the result is the same, namely, that when the grain begins to set its fruits the mycelia that have lived near the base of the flowers begin to form their hibernating tubers—the horn-like purple structures that are seen to rise up out of the spiklets until they become very considerably larger than the ordinary grains of the plant — Conidia. *Conf with* pp 6 13-14, 21, 27

Thus then should even one ascospore from a hibernating sclerotium succeed in being carried to the flowering spike of a cereal, in a very short time, with climatic conditions auspicious, the whole crop may be invaded by the conidia that will soon there after be produced

43 ***Practical Considerations and Remedies.***—Unfortunately no specific has as yet been found for this disease It would obviously be superfluous to dress the seed grains in hot water or solutions of sulphate of copper, since the spores are not entangled by the grain as in bunt and smut. — Pickling superfluous. *Conf with* pp 11, 20 30.

FUNGI

Commoner Rusts and Mildews

II
ERGOT

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Sclerotium
Conf with p. 11.

Poisonous Properties
Conf with pp. 28 30

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Hibernation
Conf with pp. 11, 17, 30, 33, 94

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Spermogonia.
Conf with 11, 71 27-30

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II. ERGOT.

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Conidia. *Conf with pp 6 13-14, 21, 27*

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Pickling Superfluous. *Conf with pp 14, 20 30.*

FUNGI | **Commoner Rusts and Mildews**

It ERGOT

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Sclerotium. *Conf with p 11*

Poisonous Properties *Conf with pp 28 30*

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Hibernation *Conf with pp 11, 17, 30, 53, 98*

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Spermogonia. *Conf with pp 32 [illegible]*

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during winter (or in the interval between the crops) in the resting or hibernating teleutosporic condition

46 ***Practical Suggestions.***—There cannot be two opinions therefore, on the immense advantage of burning all old haulm and withered rust infected leaves since these will undoubtedly communicate the disease to the fresh crops

47 Papers that may be consulted—

Rust on Indian corn (Puccinia Maydis, *Carr*), Report Commissioner, Agri United States, *1887, pp 389-391* Puccinia Maydis, *Carr*, *Agricultural Gazette, New South Wales 1891, p 215*

RUST on INDIAN-CORN

Value of burning straw

Conf with p 20

X—RUST on JUAR and BAJRA

Puccinia Pennisetl, *Plate I, Figs 1, 2 and 3*

RUST on JUAR

Conf with pp 5, 83 124 5

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49 Since Dr Barclay's death I have found this disease to be very nearly universally distributed throughout India, and, as stated above, not only on the crops named but on almost all the wild grasses in the vicinity of cultivation At times the *juar* plant (Sorghum vulgare) may be seen with every leaf (and on both sides of the leaves), literally red with the large uredo pustules There cannot be any doubt, moreover, as to the extent of injury that it causes If the observer be fortunate to discover a plant free from rust or only partially rusted, he will

* Conf with the remarks on foot note on page 98

FUNGI | Commoner Rusts and Mildews

II
ERGOT

There are, however, two or perhaps three practical ways of battling with the malady, which have been recommended by writers on this subject—

1st—An efficient system of rotation of crops. The same cereal at any rate should not be sown on a sclerotia-impregnated soil until after the lapse of such period as may ensure their destruction, that is, their starvation

2nd—The cultivators should be warned of the danger of leaving ergot infested spikes to mature and be reaped with the crop. As a rule the Indian cultivators have no lack of labour at the season when the crops are approaching maturity The infested spikes might easily enough be removed by the women and children and with great advantage to future crops, the difficulty is to convince the cultivators of the value of this procedure The sclerotia would thereby be prevented from being sown in the soil and the grain reaped a little later would be saved from the risk of being rendered poisonous

3rd—A badly *ergotised crop* should be *reaped* as early as possible, so as to prevent the sclerotia from being sown in the soil

RUST
on
INDIAN-CORN
Con. with
pp. 83 1-7

IX.—RUST on INDIAN-CORN

44 It will be found from the remarks below that Dr. Barclay identified a form of Puccinia found on maize, in this country, with P. Sorghi, *Schw* It may also be noted that he regarded the rust found on *juar* and *bajra* as a distinct species from that on Indian corn, that it was a form new to science for which he gave the name *P Pennisetl*

According to some writers on this subject, rust on Indian corn very rarely does much harm because it only occasionally occurs to an extent to materially interfere with the life of the corn Should it, however, become more extensively distributed and manifest anything like the severity of rust on wheat it doubtless would do much harm by absorbing the nourishment intended for the formation of the grain

Reproduction
by
Teleuto-
spores
Conf. with
pp. 31, 34

45 There is one point *of great interest in connection with this* form of rust as also of that met with on *juar* and *bajra*, namely, that the teleutospores would seem to have the power of germinating on next year's crop and of producing thereby the uredospores These species of Puccinia, therefore do not apparently pass through a th[illegible] or resting stage (such as is met with in wheat rust), but live

during winter (or in the interval between the crops) in the resting or hibernating teleutosporic condition.

II. RUST on INDIAN-CORN.

46. ***Practical Suggestions.***—There cannot be two opinions, therefore, on the immense advantage of burning all old haulm and withered rust-infected leaves since these will undoubtedly communicate the disease to the fresh crops.

Value of burning straw. *Conf. with p. 20.*

47. *Papers that may be consulted*—

Rust on Indian-corn (Puccinia Maydis, *Carr.*), Report, Commissioner, Agri. United States, *1887, pp. 359-391; Puccinia Maydis, Carr., Agricultural Gazette, New South Wales, 1891, p. 215.*

X—RUST on JUAR and BAJRA.

Puccinia Penniseti. *Plate I, Figs. 1, 2 and 3.*

RUST on JUAR. *Conf. with pp. 22, 83, 124-6.*

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FUNGI	Commoner Rusts and Mildews

II ERGOT

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RUST on INDIAN-CORN
Con with pp 83 1-7

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Reproduction by Teleuto-spores
Conf with pp 8, 37, 54

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RUST on JUAR *Conf with pp 52, 83 l. 1-5*

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Conf with pp 83 127

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Reproduction
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Teleuto-
spores
Conf with pp 8, 37, 54

II RUST on WHEAT.

P. Rubigo vera (and perhaps also a third, P. coronata) found parasitically on the above mentioned cereals, besides being also met with on numerous other grasses In this chapter it is intended to bring together all the scattered bits of information that have already been discussed, regarding the rust and mildew of wheat and to thus present as complete an account of that disease as may be possible The effort shall also be made to exhibit the practical considerations that hinge on the scientific discoveries

In paragraph 7 above, mention has been made of the polymorphism of wheat rust Both species of Puccinia manifests three phases and they are also heterœcious In its *first* phase, P. graminis lives on the barberry as an ÆCIDIUM, and in the early part of the year emits æcidial spores which on coming in contact with wheat give origin to the second phase—the UREDO (rust) condition Uredo-spores are then produced and these extend the malady by germinating on the wheat and producing other Uredo pustules Later on in the year the fungus undergoes its final transition by producing on wheat PUCCINIA (mildew) pustules, that discharge the teleutospores But let it not be forgotten these teleutospores cannot germinate as produced—they are hibernating spores And what is even more instructive, no satisfactory evidence has been adduced that they have at any time the power of germinating on wheat It follows that, if carried to the barberry at once, they will not germinate on it till the succeeding spring But in spring they will most undoubtedly give origin to the æcidial cluster-cups which shortly after discharge the spores that are the direct cause of rust on wheat

Germination of Teleutospores *Conf with pp 8, 31, 34.*

53 Before proceeding further it may be well to give here as briefly as possible such particulars as may help the reader to recognise the fungal organisms of these three phases of rust and mildew. In doing so it may be as well to commence with—

(*a*) The *Æcidium* *—In Europe during spring the leaves of the barberry may often be seen to be speckled with yellowish-pink or purple swellings which deepen in colour as the season advances (*Fig 7, next page*) If these be carefully examined with the aid of a good lens it will be found that there are on the upper surface of the swellings very minute pores or puncturings (*Fig 8 sp*), each of which is surrounded or rather obtruded by a tuft of very delicate

ÆCIDIUM. *Conf. with pp. 8, 30-31.*

* Derived from a Greek word meaning destructive or injurious.

FUNGI	Commoner Rusts and Mildews

II RUST on JUAR

have little difficulty in discovering the very much larger percentage of well-formed healthy grains in the one spike as compared to the other Indeed, it is by no means an unusual occurrence to find what appears large prolific heads of *juar* that on inspection are found to practically contain no grains whatever or rather a mass of abortive grains

50 Another point of great practical interest, exists in the fact that there are unmistakable evidences that certain races of *juar* are much less liable than others to the disease It will be found in the remarks below, on the subject of wheat rust (*pp* 59 70), that the most rational cure for rust as yet contemplated, is the production by selection and crossing of new races of wheat that may be practically proof against the disease As in the case of wheat so in that of *juar*, the forms that produce abundance of the white waxy exudation enjoy a remarkable immunity from rust (*p* 69)

Glaucous Forms *Conf with pp 62, 69*

To deal with this question here would, however, amount practically to traversing the same ground as can be more satisfactorily done in the concluding chapter on wheat The reader is, therefore, referred to Chapter III for further particulars, the remark only being added that, so far as can be learned, everything that has been accomplished in the improvement of wheat in Australia might, and most certainly should, be tried in India with both wheat and *juar*

Teleutospores on withered haulm *Conf with pp 13 43, 63, 98*

51. *Practical Recommendation.*—The presumption being that the rust of *juar* and *bajra* are communicated from the teleutospore infected haulm and withered leaves of last year's crop, an important check would be given to the spread of the disease were a more careful and cleanly agriculture pursued The burning of all traces of last year s waste materials should be imperatively followed, and before the crops have germinated all rust infested grasses should be removed from the fields

Losses see p 78

Were some such reforms carefully pursued, by the cultivators of a neighbourhood, the gain might be found to be very little short of an increased outturn per annum of close on 20 per cent

For Rust on Buck wheat see pp 83, 115, on the Strawberry, p 116

RUST on WHEAT *Conf with pp 5 83*

XI —RUST and MILDEW on WHEAT, BARLEY, and OATS, etc ,— Fungi that belong to the Uredineæ—a family of the BASIDIOMYCETES (*Conf with p 5*)

1st Puccinia graminis

52 There are two species of Puccinia, viz , P. graminis and

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ÆCIDIUM. *Conf. with* *pp. 8, 80-81.*

* Derived from a Greek word meaning destructive or injurious.

II
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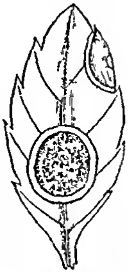
on
WHEAT
ÆCIDIUM

hairs On the under surface of the swellings will be seen fairly large "cluster cups' (*Fig 8 Æ*), the rims of which appear to have burst through the epidermis of the barberry leaf

FIG 7



Barberry leaf showing Æcidial patches of deep purple with pale yellow ring round the circumference

Dr Barclay tells us (*see pp 83 118*) that identically similar structures are formed on the three species of barberry commonly found on the Himálaya, but that he was unable to determine whether the æcidia on all three species of barberry were the same or different forms To this I may perhaps add that I have never observed æcidial swellings at very much higher altitudes than 8 000 to 9 000 feet, the alpine species of barberry, for example, are usually free from such parasites Nor have I observed the parasite on Berberis nepalensis—a species formerly referred to the genus Mahonia—though of other countries it is stated that the fungus has been found by certain observers on species of Mahonia It is also worthy of record that the barberry bushes on the outer (or southern) ranges of the Himálaya are more profusely attacked than those of the interior tracts But Dr. Barclay draws attention to a point of great importance, *viz*, that instead of appearing in spring the æcidial swellings of the Himálayan species of barberry are formed about August The practical effect of this will be found discussed in a further paragraph (*p 53*)

Æcidial Season
C nf with 53, 57.

It may also be here noted that the pores on the upper surface are formed in point of time before the cups on the under Spores

or rounded spore-like bodies are discharged from both orifices. Those on the upper surface are infinitely smaller than of the lower, and they are almost pure white. If these spores be placed under conditions usually favourable to germination, it will be ascertained that *the smaller white spores refuse to germinate* (*Conf. with next page*), but that the larger yellow ones do so freely.

II. RUST on WHEAT. *ÆCIDIUM.*

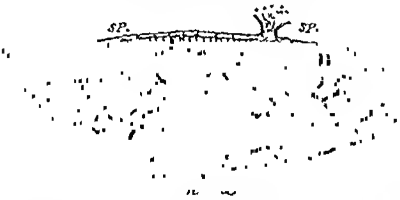
54. If now a section be made through the barberry leaf taking care to cut across the thickened swelling, it will be discovered that the pores on the upper surface open into small rounded flask-like structures more or less filled up with the delicate hairs that have been spoken of as protruding from the mouth; these hairs are known as *paraphyses* (*Fig. 2, p. 6*). Between the *paraphyses and placed low* down in the conceptacle will also be noticed short clinodes or hyphæ that give off by a continuous chain like separation the minute spores that are discharged on the upper surface of the leaf.

Paraphyses *Conf. with pp. 6, 48, 96, 100.*

55. The conceptacles or pustules, imbedded on the upper surface of the æcidial swellings, have been designated SPERMOGONIA (*Fig 8 sp.*) and the spore-like bodies discharged from them, the SPERMATIA. But now comes the most remarkable feature of these spermogonia and spermatia,—no person has as yet discovered the function they perform. Speculating on what might be designated analogy, they

Spermogonia *Conf. with pp 32, 49.* Spermatia.

FIG. 8.



Section through the swelling on the leaf of the barberry showing on upper surface spermogonia (sp.) the one to the right discharging spermatia, and on the lower surface Æcidial cluster cups (æ), the one to the left having burst ... also undergone a ... greatly enlarged ... and the hyphæ (h.) that discharge the æcidiospores.

F. 725.

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RUST
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ÆCIDIUM
Conf with Dr Cobb s remarks p 49

have by some writers been supposed to exercise a male or fecundating influence, but no evidence has been adduced in support of this opinion Dr. Cobb (*Agricultural Gazette, New South Wales, Vol. III, p 56*) says, however, that "It is known they will germinate after the manner of yeast plants in solutions of sugar" "Spermatia have never been known by their germination to produce any other form of fungus."

56 Fortunately, however, so far as our study of rust is concerned, we can leave the enigma of the production of spermatia for the mycologist to solve and torn our attention to the cluster cups At first these are seen, like the spermogonia, to be globularly-formed cysts of a clearly foreign nature, formed within the tissue of the barberry leaf (*Fig 8, Æ*) Under the microscope they are discovered to be

Peridium
Conf with pp 8, 42

distinct conceptacles, consisting of a wall of cellular tissue or peridium (*Fig 8, p*), that takes its origin from a minute mycelial structure that may be traced out within the tissue of the leaf The interior of these conceptacles, and towards the base, is seen to be closely packed with short radiating hyphæ (*Fig 8, h*) which form a compact

Clinodium
Conf with pp 7, 8, 17

mass or clinodium From the extremities of these hyphæ are produced chains of spores, very similar, in the method of their formation, to the spermatia, though they are larger and of a yellow colour. When the spores (which from being produced in æcidial pustules are designated æcidiospores) have reached maturity, the portion of the leaf epidermis over above each pustule, turns almost scarlet, then ruptures, not in the form of a pore, as in the spermogonia, but in a more or less regular manner so that together with the cyst wall (or peridium) it becomes reflexed in the form of a toothed lip From the cluster cup thus formed is poured out (in Europe during the months of April to June or even July) countless myriads of æcidiospores The spore bearing hyphæ, both in the spermogonia

Basidia
Conf with pl 4 & 6, 9, 40, 100

and in the æcidial cups, are, therefore, closely homologous to the basidia of the toadstool or better still of the puff ball.

57 But now comes the marvellous feature of these organisms Placed under favourable conditions, the æcidiospores manifest rapidly the power of germination, but if in that state they are placed on the leaves of the barberry, they die without making any attempt to penetrate Though produced on the barberry they have no power of renewing their growth on that plant This leads naturally, therefore, to the consideration of the conditions under which they may be pro-

F. 725

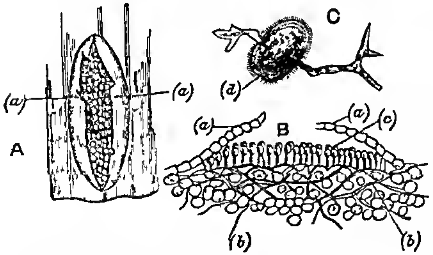
II. RUST on WHEAT.

pagated In this connection the reader should, however, consult Dr Barclay's descriptions of the Himálayan barberry æcidia which will be found in paragraph below (*p. 118*) before proceeding to study the effects of the *germination of the æcidiospores*

UREDO *Conf with pp. 8, 37, 84, 128.*

(*b*) Uredo or Rust —If, however, the germinating æcidiospores (*Fig 9, C.*) be placed on the leaves or stems of young wheat plants, they will be seen to at once take root, so to speak, and in a very short time produce the orange-yellow pustules known as rust. Their sprouting hyphæ penetrate the leaves and stems of wheat, oats, and many other species of grasses, and immediately ramify within the green tissue [*Fig 9 (bb.)*], just below the epidermis. They quickly form an extensive mycelium with branched and septate hyphæ, the presence of which is soon indicated by the resulting pale and exhausted colour of the host. In about 10 to 15 days the mycelium sends forth special hyphæ towards the epidermis and very often within the air spaces, just underneath the stomata These hyphæ become more or less compacted together into sori like * clusters

Fig. 9



(A) Linear oblong sorus of **Puccinia graminis**, parallel to the veins of the leaf, —enlarged 40 times, (B) Section through the same showing (a.a.) the ruptured epidermis (b b) the mycelial filaments ramifying within the loose cellular tissue of the leaf, and (c) the closely packed uredo spores on their clinodes (C) A germinating uredospore with its roughened coat showing two germinal tubes escaped by the germinal pores on its equator, (d) the point of severance from the clinode

* Sorus, the Greek word for a cluster, used in botany to indicate the spots and bands of spores seen on the under-surface of ferns. *Conf with pp 43 47.*

FUNGI	Commoner Rusts and Mildews

II
RUST on WHEAT
UREDO

(*Fig 9 A*) but are not enclosed by a peridium Each hypha in due course comes to bear on its extremity a small oblong or rather elliptic-oblong spore [*Fig 9 (c)*] which on reaching maturity is thrown off from its pedicel to make room for the other spores that are being pushed up from below In course of time the accumulation of uredospores and the activity of the upward growth, ruptures the epidermis of the host (*a a*) and exposes the orange-yellow uredospores. In Puccinia graminis the sori of rust assume the form of much longer or more linear bands than P. Rubigo-vera (*Fig 11, pages 45, 47*) (a species to be described hereafter), and are seen to run up and down the tissue of the leaf or stem in vertical rows (*Fig. 9 A*) that are sometimes aggregated together laterally into fairly large irregularly-shaped patches (*Fig 11, A*).

Two Forms of Rust
Conf with pp 47, 96

Germinal pores
Conf with pp 47, 96, 100 108, 111

58 If now one of the uredospores be examined under the microscope (*Fig 9 C*), it will be found to be about one thousandth part of an inch in size, to have a fairly thick double cell wall, with a few (generally four) transparent pores or spots near its equator Its outer surface will also be seen to be thickly beset with minute spines, intended to assist it in adhering to whatever it may be brought in contact with But it may be witnessed also to manifest a property that is of vital importance for us to record in the study of wheat rust If favourable conditions (damp warm atmosphere) are afforded it will germinate in a few days after its discharge from the uredo pustule If the necessary conditions be not afforded it will die * On germination one or two of the transparent spots, already mentioned, may be seen to throw out little protuberances These extend and ultimately one may be observed to grow more rapidly than the other (*Fig 9 C*), to become branched, and gradually to drain from the spore its orange coloured and oil like granules and liquid contents If now the germinating spore be placed on a young and living wheat shoot the elongating hypha will be seen to rapidly enter the tissue of the wheat by passing through one of its stomata or breathing mouths The remarkably instinctive movement towards the stomata has been explained as possibly due to the currents of oxygen being discharged from these minute breathing mouths The movement is rapid and definite and the after-results may be carefully studied by having the inoculated leaf held under the field of the microscope so that it may be inspected from time to time

Germination

Penetration of Wheat
Conf with p 63

* Uredospores with exceptionally long vitality—see p 114

It may be noted that the uredospores give birth to fresh uredo pustules and that for a few months the fungus lives in this phase of its existence and extends its devastation perhaps for miles around, the uredospores being disseminated by rain quite as rapidly as by wind

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UREDO Transmission Conf with p 61

59 Rust is, therefore, the early and mid summer form of the disease, but in time the uredo pustules may be seen to produce one or two darker-coloured spores of a different shape to those just described and ultimately to discontinue the production of the orange-coloured or rust spores This leads us therefore, to consider the third phase of the fungus

(c) Puccinia or Mildew —When the aid of the microscope was first obtained in the study of this subject, the very different appearance of the dark coloured spores formed in autumn to those of spring led to the opinion that they were independent fungi, unconnected with the uredo When it is recollected how very minute these organisms are and the difficulty of being able to actually trace out the formation of a puccinia bearing hypha to the same thread of the mycelium that had some months before borne a uredo the error will be understood into which the mycologists of a few years ago had fallen This difficulty was increased by the fact that had been known for many years, viz, that one fungus may live parasitically upon another The Puccinia might therefore, very easily have been mistaken for a parasite on the Uredo When once other circumstances led, however, to the acceptance of the polymorphism of many fungi, direct experiment established what the microscope failed to reveal There is now no longer any doubt that the Puccinia are but later pustules of the same fungus as the Uredo, destined to produce a kind of hibernating spore and by a process similar to that which has been described in the formation of the uredospores These later (or autumn) spores it has already been explained have been designated teleutospores, they are larger longer, divided by a transverse partition, are also darker coloured and borne on longer hyphæ than the uredospores but they are produced within pustule like sori very similar to those already described (*Fig 19 B*) They are not thrown off so quickly, however as in the former case and indeed may remain attached to the pustules on the withered fragments of the host for two or three years and still retain their vitality They are hibernating spores that are intended to bridge over the period when the wheat

POCCINIA Conf with pp 8, 18, 49 50

One Fungus parasitic on another Conf with p 7

Teleuto spores Conf with pp 8 34, 36 37, 64 96 Fig 10

FUNGI.	Commoner Rusts and Mildews

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with no appreciable thickening and are borne on exceedingly short stalks; *they are also smaller and lighter coloured than in* P. graminis. Compare this description with the appearances of the teleutospores, *Fig. 10*; and with the description of P. graminis. The pseudospores *themselves* are at *the same time smaller than in* P. graminis, and, as first pointed out by Dr. Barclay, they are not in India as in Europe accompanied with pharapyses—a peculiarity of some interest since in Australia, *Dr. Cobb* tells us, paraphyses are met with among the teleutospores. It is thus somewhat remarkable that in warm countries where this form of rust appears to be perpetuated without having to pass through an æcidial stage, there should also be other structural differences.

P. coronata. *Conf. with pp. 102-110.*

A third species of Puccinia has (in Europe) been found to occasionally produce rust on wheat, oats barley, etc., *viz.*, P. coronata. It will be seen from the passages quoted below that Dr. Barclay found this Puccinia spending its æcidial stage on a species of Buck-thorn—Rhamnus davuricus—(just as in Europe), but that he was only able to discover its uredo-and teleuto-spores on certain wild grasses (Brachypodium sylvaticum, Piptatherum holciforme and Festuca gigantea) and not on wheat.

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CHAPTER III.

SOME GENERAL CONSIDERATIONS REGARDING RUSTED WHEAT WHICH HAVE A BEARING ON THE STUDY OF ALL FUNGOID BLIGHTS.

65. ***Practical Considerations and Experiments.***—Having thus briefly detailed the more striking facts regarding the three stages in the life of **Puccinia graminis**, attention may be directed to some general considerations that may be supposed to be gradually piecing together a new chapter in our knowledge of this remarkable plant In his address to the Rust Conference, held in Sydney in June 1891, Dr. Cobb alluded to an observation that may possibly be found pregnant of meaning Neither in the subsequent reports of the other Conferences (held in Australia), to which I have had access, nor in the *Agricultural Gazette* of New South Wales, Vols I, II and III, do I find, however, any further allusion to the observation in question Dr Cobb's remarks, as reported in the proceedings of the second Conference, were as follows,—

"The other rust, which does the more damage in Northern Europe (Puccinia graminis), exists also in wheat all the year round, and specimens I have received from Wagga Wagga of a native grass (Agropyrum scabrum), related to wheat, have rust on them late in the autumn and during the winter, which is absolutely identical with P graminis as to structure, if we except this difference, that among its red rust spots there are certain black bodies which may constitute a fourth spore of the rust. Whether this shows that the Agropyrum rust is different from that which occurs on wheat is a matter for experiment, but should these spores produce rust on wheat we shall have evidence that P graminis exists throughout the winter on certain native grasses Although our observations point to the fact that spring rust did nearly all the damage last season, there are certain indications that this other rust (P. graminis) would be likely to do great damage in certain seasons particularly the fact that it is a very vigorous rust It appears in long lines. I believe it was agreed that in 1889 the rust which did the damage was in long lines and not in small spots. If this is true, that rust may have been Puccinia graminis. In ordinary seasons, however, if this last season may be taken as an example, it is spring rust that does the damage. As a result of my investigations, I have been able to discover the existence of Australian rusts to the number of about fifty, in the large majority of which I have found pustules closely

Uredo survival Conf. with pp. 8, 12, 31-33.

Fourth Rust Spore.

Spermogonia Conf. with pp. 37, 39, 100.

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allied to what are known to botanists as Spermogonia, and furthermore, I have been able to take spores from them and cause them to germinate * Hitherto, these bodies (providing I am right in calling them spermogonia) have never been known to produce spores that germinate in the ordinary sense of that word—that is, to throw out a mycelium"

66 It is unfortunate that Dr Cobb did not think it necessary to mention the host plants on which he found at least some of these germinating "spermogonia' spores As it stands the statement is a little confusing, the more so seeing that it comes on the back of his announcement of the discovery of some fifty "Australian rusts,' which, from the context, it may be assumed are species of Puccinia Indeed his remarks, if correctly reported, would seem to have given origin to what are apparently incorrect conclusions Thus, for example, in the Report of the Committee on the second Wheat Conference, published in the Annual Report of the Department of Agriculture, Brisbane, 1892 (*page 6*), and in the *Agricultural Gazette* of New South Wales (*Vol II, p 403*), the following passage occurs —

'On reference to the papers and records of experiences presented to the Conference it will be seen that certain discoveries of an interesting nature have been made in regard to the predominence of the Spring Rust (Puccinia Rubigo vera) in the Colony of New South Wales during the past year, and a possible fourth stage of the Autumn Rust (P. graminis), on a species of Agropyrum the presence of germinating cells in the spermogonia of the same rust, etc"

Now it would seem that Dr. Cobb's discovery of "certain black bodies' in the P. graminis found on the grass Agropyrum was a quite independent fact from his observation regarding the germinating cells of spermogonia Indeed Dr. Cobb tells us in other papers that he has not personally witnessed the whole process of the formation of the æcidia of P. graminis or of P. Rubigo-vera Spermogonia are structures of the æcidial stage in the life of species of Puccinia, hence it follows that his observation regarding spermogonia was unconnected with the rust on wheat The point of greatest inter[illegible] in Dr. Cobb's addre[illegible] [illegible] appear, however, to turn on his re[illegible] [illegible] a fourth s[illegible] rust [illegible]

* This germination or rath[illegible] [illegible] m of Smut
d[illegible] covery of the year I ke grow[illegible]
see [illegible] and pages [illegible] —

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It is hardly possible that so accurate an observer could have mistaken the commencement of the formation of teleutospores, in the centre perhaps of an uredo pustule, as a fourth spore-formation From the passage quoted below (p 129), from Dr. Barclay's papers, it will be seen that he discovered upon a Himálayan species of Agropyrum a fungus of so different a nature from the Puccinia graminis or P. coronata of previous observers that he was induced to refer it to Uromyces and gave it the name of U Agropyri. It is, therefore, just possible that Dr. Cobb's observation and that previously recorded by Dr. Barclay, regarding a parasitic fungus found on Agropyrum, may relate to one and the same thing. If Dr. Barclay's view be supported by future investigators, the fungus, so far as we know, could have no possible bearing on the problem of rust in wheat On the other hand, if Dr. Cobb's view receives confirmation it may prove of the utmost value, since there would seem no doubt but that a fourth spore, perhaps produced through the germination of the teleutospores with the production of a resting-spore or at all events of some organism that had the power of germination on wheat, without the intervention of a second host, would solve the present difficulty that besets the study of wheat blight.

Uromyces Conf with pp 20 84 129

67. The discovery of what appears to be a distinct sexual system (possessed by a certain species of Æcidium) was first announced by Mr. George Massee of Kew This may ultimately have a direct bearing on the question of the rust in wheat, but so far as we know at present there is a great gap, following the production of teleutospores that is by no means filled up by the well established fact that when afforded the opportunity of doing so, Puccinia graminis exists as an Æcidium on the barberry

68 *Spore Distribution.*—It is well known that the atmosphere is at all times and in all countries highly charged with spores and other minute organisms Dr. D D. Cunningham published in 1872 (*9th Annual Report of the Sanitary Commissioner with the Government of India*) the results of his microscopic examination of the air. The majority of the organisms found by him were living and ready to undergo development if brought under suitable conditions Dr. Carruthers, in an interesting paper On wheat mildew' (*Journal,*

Spore Distribution. Conf with pp 19, 20, 25.

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Royal Agricultural Society, England, Vol 43, page 495), says on this subject:—

"The quantity of spores produced in the cups on a single barberry leaf is enormous It is impossible to realize the myriads of fungal spores which are floating in the atmosphere during the greater part of the year, ready, whenever the fitting physical conditions are present, to germinate No place is free from their presence They are so minute that we see them only as motes dancing in the sunbeam But though so minute, they are mighty agents for good or for evil, because of their extraordinary quantity."

It is not therefore impossible that the wheat rust of the plains of India could be caused by the barberry bushes of the Himálaya, but it is improbable that this is so And there are *many circumstances that* support that *opinion* In other countries where the barberry is unknown this particular form of rust prevails The late Dr Barclay (*Jour As, Soc., Bengal, Vol LVIII, Part II., page 249, and Journal of Botany, Vol 28, page 257*) was the first observer who drew attention to the very *remarkable fact that on the Himálaya, where the barberry is* abundantly covered with the cluster-cups of the æcidium that in Europe is known to give the rust, Puccinia graminis, the wheat of the Himálaya is not rusted by that species but by Puccinia Rubigo-vera. *Dr. Barclay says* —

"Whilst *P. Rubigo-vera is apparently by far the commonest Rust in India, P graminis is not wholly unknown I have received speci*mens of P graminis from Jeypore, about 200 miles in a direct line from *the nearest known habitat of barberry, but I have never seen a specimen* on the crops actually in the neighbourhood of æcidium bearing barberry"

In the Dictionary of Economic Products Volume VI, Part III, page 299, I had occasion to allude to this subject in speaking of the rust on *Juar* The following remarks were then offered —

Conf with p. 30

"The writer had the pleasure to enjoy the *late Dr Barclay's confidence* and friendship During many botanical excursions he discussed with him the value that might be placed on the fungoid diseases of plants, as supporting other arguments that might be advanced in tracing out the nativity of crops The problem that distressed Dr Barclay most was the fact that, while the barberry æcidium-bearing bushes of the Himálaya were yearly attacked, the rust of the Himálayan wheat fields was not connected with the barberry. *During our last botanical excursion* together, however, the writer had the good fortune to find in a field close to Mutiyana (Simla) a crop of wheat attacked with both Puccinia Rubigo-vera and P graminis and underneath the crop a Bromus at f

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Polygonum, also attacked with uredines in a remarkable manner With out the aid of the microscope Dr Barclay was unable to do more than speculate as to whether it was possible the Polygonum (which he had never before found attacked by a uredine) could be the cause of the rust on the wheat of the plains of India Shortly before his death Dr Barclay told the writer, however, that he had been able to prove that the Poly gonum very probably had nothing whatsoever to do with Puccinia graminis, but was a well known species found on the same Polygonum in Europe (P aviculare) There remained, however, he added, the fact that the hosts of P graminis as well as of P Rubigo vera were both very likely to be found at Muttiyana Dr Barclay was hopeful that he would thus soon solve the problem of the wheat rust of India. Unfortunately, his death within a few days after the conversation detailed above, closed a brilliant career, all too short for the obligations laid upon him by the necessities of India in a field of research in which Dr Barclay had no equal and no successor."

69 **Season of Æcidial Production.**—One of the features of Dr Barclay's investigations into the subject of the rust on the wheats in the Simla district, as it seems to me, deserves to be brought forward in a more pronounced manner than has as yet been done He found **Puccinia graminis**, as he repeatedly informs us on a wild grass. He took the teleutospores from that grass and, so to speak inoculated the barberry I had the pleasure to witness a young barberry bush, upon which beyond question he had produced the *æcidial pustules* He then *took the spores from these pustoles* and produced the uredo condition on the grass But he failed absolutely to communicate rust to wheat from the barberry, *owing to the æcidial spores having ceased to be produced by the time wheat was on the fields* He did not thus prove that the æcidial spores of the Indian barberry had not the power to originate rust on wheat but that the period of their discharge did not correspond with the existence of wheat either on the hills or in the plains He was, however, in hopes that from the recent discovery of **P. graminis** on the wheat fields of Muttiyana he would be able to ascertain whether or not it was extended in the uredo stage from one set of wild grasses to another, until ultimately it reached the wheat crop (*See next page*) But if this be at all possible it is very surprising that it does not always occur, and that in Simla we should have the barberry bushes annually covered with the æcidial spores, which Dr Barclay was able to demonstrate did actually give **Puccinia graminis** to certain wild grasses, while the wheat crop is annually attacked by a rust uncon-

Æcidia Season. *Conf with pp. 38, 97, 118.*

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nected with the barberry and the alternative æcidial stage of which he had failed absolutely to discover.

Hibernation.
Conf with pp 9 11, 13 32, 98.

70. ***Mycelial Hibernation.***—In Australia and other countries where rust has for years past done much damage to the wheat crops, the practice is all but universally followed of burning the stubble on the field and of carefully avoiding to manure the new wheat fields with firm-yard manure that might contain rusted straw But if the wheat teleutospores have no power (as has been affirmed by all observers who have investigated this subject) of germinating on wheat and of producing the uredo condition, it is difficult to see wherein the advantage lies of this extravagance

If it can be demonstrated that there is an advantage (as seems to have been established in Australia), then either the theory of the non-fertility of the teleutospores on wheat is incorrect (*see p 37*) or something equivalent to a resting spore or hibernating mycelium must be produced by the **Puccinia** of which we have at present no knowledge Dr. Barclay (*page 98*), it will be seen, alludes to the belief that **P. Rubigo-vera** may produce a hibernating mycelium on the roots of grasses, but even that opinion he does not appear to have determined by actual experiment.

Uredo Transmission
Conf with p 43

71. ***Uredo Transmission.***—If rust be perpetuated in the uredo stage only, passing through the wheat crop and then leaving it to survive, still in the uredo stage, on the wild grasses around the fields (as we are informed by Dr. Cobb is the case with **P. Rubigo-vera** in *Australia*), whence comes the necessity for producing teleutospores? It surely would be a useless survival for the plant to continue to waste its energies in producing teleutospores, while it had dispensed with the necessity for æcidial spores

Uredo Survival
Conf with p 98

Dr. Barclay tells us that he had failed absolutely to trace out any survival on the grasses in the Simla district, and if such existed he certainly would have detected it It may be affirmed that the study of wheat rust has in no country been pursued by a more patient and skilled investigator than Dr. Barclay His failure in this direction is, therefore, almost sufficient to justify the condemnation of the non scientific reports that would have it that it is in this way that the rust of the plains of India is perpetuated During my tour through the wheat district of the Central Provinces

and Berar, in November and December 1894, I collected samples of all the rusted grasses I could find on or near wheat fields These have been obligingly examined by Dr. D D Cunningham, who reports that in every case they are allied to the rust on **Sorghum**, but not to **P. Rubigo-vera** of wheat. III RUST on WHEAT

72 ***Uredo Interchangeable.***—But there remains to be demonstrated a practical consideration of the greatest moment, *viz*, whether it is or is not a fact that **Puccinia graminis** or **P. Rubigo-vera**, as found on wild grasses or on graminaceous crops, may be transmitted to wheat. The remark has been made already that parasitic fungi are remarkably accurate in the selection of their hosts They are often seen to be confined to certain varieties or are never found on other forms Dr. Barclay has on more occasions than one expressed surprise that individual plants of the same species often seem to enjoy complete immunity from a parasitic disease that is prevalent on the numerous plants of that species in close proximity. Uredo Interchangeable. *Conf with pp 8, 10, 22, 60*

As having a direct bearing on this all-important question as also on the problem of mycelial hibernation, reference may be here made to certain investigations that have been instituted At the Experimental Station, Kansas State, for example, experiments with these objects in view have been conducted and the results published in the Bulletins (Nos 38 of 1893 and 46 of 1894) issued from the Agricultural College These results, in the opinion of Mr A. S Hitchcock, seem to have been thought to justify certain definite conclusions that may be here briefly summarised —

(*a*) That in Manhattan *Puccinia Rubigo-vera* passes the winter in the tissue of the wheat plant in the mycelial condition Latent Mycelia.

(*b*) *That during the warm weather of spring a crop of spores is* produced which, under favourable conditions, may rapidly spread the disease

(*c*) That the infection of winter wheat in the fall is materially aided by volunteer wheat, which carries through the few months following harvest

(*d*) That the red rust spores are capable of maintaining their power of germination through the winter and thus of infecting the crop the following spring Vitality of Uredospores. *Conf with pp 105, 114*

The criticism would seem fairly justifiable, however, that these opinions are based on purely artificial experiments The experiments may, in fact, be said to show what might occur, not by any means

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Vitality of Uredospores. *Conf with pp 108 114*

The criticism would seem fairly justifiable, however that these opinions are based on purely artificial experiments The experiments may, in fact, be said to show what might occur, not by any means

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what actually occurs. It would, of course, be possible (under glass in cold countries or by reducing the temperature in tropical regions) to supply the parasite with continuous crops of its host and thus to produce uredospores for an indefinite period. But a feat of that nature could hardly be advanced in support of a conclusion of universal occurrence on the fine demonstrated by such purely artificial means.

The Kansas reports do not seem to afford sufficient evidence in support of the views advanced. On the contrary, the statement that immediately follows the particulars briefly reviewed above might be held as inimical to any idea of actual uredo survival. An interesting series of experiments were performed in order to test the value of the popularly accepted view that the rust extends rapidly from one kind of graminaceous crop to another, or from wild grasses to the field crops. The experiments in this case would seem to justify the opinion finally arrived at, *viz.*:—

Uredo not Interchangeable.

(e) That a series of inoculation experiments show that both wheat and oats are easily infected by rust from the same kind of grain, but not by the same kind of rust from other grains; *e.g.*, wheat is infected by rust from wheat, but not by rust from oats, corn or blue grass. Hence there is no danger of infection from one kind of grain to another.

This then is perhaps the most interesting result of the Kansas experiments. For rust to survive in the uredo stage, therefore, we have practically to presume the existence of a continuous series of "volunteer" (that is to say, self-sown) plants of the crop, covering the entire period between harvest and next year's seedlings. Dr. Cobb tells us that in Australia this actually takes place. In countries that do not have a severe climatic isolation between the seasons of wheat cultivation, volunteer survivals of the crop might easily enough occur. Where this is met with the existence of uredospores might be made a matter of actual observation, and their vitality tested at repeated intervals, without having to call in the aid of improbable experiments.

I have never seen any "volunteer" rusted wheat in India. Indeed the tropical summer that succeeds the wheat season would render this next to impossible. We have but a very limited summer wheat crop, and the plant then grown is so different from the crop reaped in spring that I very much doubt the possibility of their rusts being interchangeable.

F. 725.

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Æcidial Host.

73. ***Other Æcidial Hosts.***—It has been affirmed that the teleutospores may possibly in India infect some other second host than the barberry, and that the life history of **P. graminis** may be regularly gone through, though we are in ignorance of its whereabouts during the æcidial stage While not of course prepared to deny the possibility of this solution of the difficulty, there are certain arguments of weight against it Observers in Europe, America and Australia have failed to discover the æcidium of **Puccinia graminis** on any other host save the barberry Fungi very rarely manifest a wide range of variability in this matter During my recent tour in the Central Provinces and Berar, to which reference on more than one occasion has been made, I failed absolutely to discover an æcidial fungus *on any of the weeds in the vicinity of the young wheat, that could be* said to be in any way connected with either of the two forms of rust Personally, therefore, I am disposed to believe we must accept the position taken up by investigators in other countries, *viz*, that **P. graminis**, though beyond question it will go to the barberry and complete its life cycle, should it get the opportunity of doing so, has the power of, and does actually, reproduce itself without passing through an æcidial stage at all and, what is more remarkable still, **P. Rubigo-vera** seems in India to dispense with the necessity entirely of an æcidial stage How this is accomplished we are at present in complete ignorance Future investigators should, therefore, direct their attention almost wholly to this feature of the case

But there is a still *further* suggestion that *I* offer with considerable hesitation namely, that we may be mistaken in thinking the rust of the plains of India is **P. Rubigo-vera** It may prove an entirely new species and in that case we need not look for its æcidial spores on a species of Boragineæ In part support of that suggestion I would mention the fact that in India the teleutospores are not associated with paraphyses

Conf with Dr Barclay's Description, p 66

74 ***Manure.***—In India manuring wheat fields may be said to be only practised to a limited extent and to be governed more by inability to do so than by disfavour, but in certain tracts of country manure is never given directly to wheat fields Statistical returns as to the relative frequency and severity of rust in such tracts of country, say, as the Narbadda valley (where manuring is practically unknown) and the Nagpur Division of the Central Provinces (where the wheat

Conf with pp 86 87.

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The Kansas reports do not seem to afford sufficient evidence in support of the views advanced On the contrary, the statement that immediately follows the particulars briefly reviewed above might be held as inimical to any idea of actual uredo survival An interesting series of experiments were performed in order to test the value of the popularly accepted view that the rust extends rapidly from one kind of graminaceous crop to another, or from wild grasses to the field crops The experiments in this case would seem to justify the opinion finally arrived at, *viz.* —

Uredo not interchangeable

> (e) That a series of inoculation experiments show that both wheat and oats are easily infected by rust from the same kind of grain, but not by the same kind of rust from other grains; e g, wheat is infected by rust from wheat, but not by rust from oats, corn or blue grass Hence there is no danger of infection from one kind of grain to another.

This then is perhaps the most interesting result of the Kansas experiments For rust to survive in the uredo stage, therefore, we have practically to presume the existence of a continuous series of "volunteer" (that is to say, self sown) plants of the crop covering the entire period between harvest and next year's seedlings Dr Cobb tells us that in Australia this actually takes place In countries that do not have a severe climatic isolation between the seasons of wheat cultivation, volunteer survivals of the crop might easily enough occur Where this is met with the existence of uredospores might be made a matter of actual observation, and their vitality tested at repeated intervals, without having to call in the aid of improbable experiments.

I have never seen any "volunteer" rusted wheat in India Indeed the tropical summer that succeeds the wheat season would render this next to impossible We have but a very limited summer wheat crop, and the plant then grown is so different from the crop reaped in spring that I very much doubt the possibility of their rusts being interchangeable.

III RUST on WHEAT. Æcidial Host.

73. ***Other Æcidial Hosts.***—It has been affirmed that the teleutospores may possibly in India infect some other second host than the barberry, and that the life history of **P. graminis** may be regularly gone through, though we are in ignorance of its whereabouts during the æcidial stage While not of course prepared to deny the possibility of this solution of the difficulty there are certain arguments of weight against it Observers in Europe, America and Australia have failed to discover the æcidium of **Puccinia graminis** on any other host save the barberry Fungi very rarely manifest a wide range of variability in this matter During my recent tour in the Central Provinces and Berar, to which reference on more than one occasion has been made, I failed absolutely to discover an æcidial fungus on any of the weeds in the vicinity of the young wheat, that could be said to be in any way connected with either of the two forms of rust Personally, therefore, I am disposed to believe we must accept the position taken up by investigators in other countries, *viz*, that **P. graminis**, though beyond question it will go to the barberry and complete its life cycle, should it get the opportunity of doing so, has the power of, and does actually reproduce itself without passing through an æcidial stage at all and what is more remarkable still **P. Rubigo-vera** seems in India to dispense with the necessity entirely of an æcidial stage How this is accomplished we are at present in complete ignorance Future investigators should therefore, direct their attention almost wholly to this feature of the case

But there is a still further suggestion that I offer with considerable hesitation namely, that *we may be mistaken in thinking the rust of the plains of India is* **P. Rubigo-vera** *It may prove an entirely* new species and in that case we need not look for its æcidial spores on a species of Boragineæ In part support of that suggestion I would mention the fact that in India the teleutospores are not associated with paraphyses

Conf with Dr Barclay's Description, p 96

74 ***Manure.***—In India manuring wheat fields may be said to be only practised to a limited extent and to be governed more by inability to do so than by disfavour, but in certain tracts of country manure is never given directly to wheat fields Statistical returns as to the relative frequency and severity of rust in such tracts of country, say, as the Narbadda valley (where manuring is practically unknown) and the Nagpur Division of the Central Provinces (where the wheat

Conf with pp 86 87.

FUNGI.	Commoner Rusts and Mildews

III RUST on WHEAT

Uredo Season of Appearance *Conf with* 1 p 87, 89

fields are said to be manured at least once every three years), would be highly instructive Were it shown, for example, that the Nagpur districts suffered more, especially after manure, than the Narbadda, some light might be admitted as thereby thrown on this subject But it would be necessary to record almost telegraphically from the districts to head-quarters when rust had appeared Mr Farrer of New South Wales says that "rust begins to appear a few days after the plant has gone out of bloom" Mr Inglis says of SOUTH AUSTRALIA that rust is frequently seen before the plants are six inches high. In a country of such magnitude as India it is possible that just as in Australia a very considerable latitude would have to be allowed as to the season of appearance of rust The first rusted leaf seen, not the first large tract of country affected, would be the important point, for when once it has started the rapidity of its distribution would render deferred observations of little practical value

Conf with 1 p 53, 87

Manure *Conf with* 1 p [illegible] 31, 51, 57

But direct experiments might easily be performed to test the affects of manuring For this purpose cattle should receive both as food and bedding a certain percentage of rusted straw The manure so derived should be employed on a plot of wheat land as far removed from other wheat fields as possible As soon as the crop appeared above ground, the field should be inspected *daily* and a registration kept of the observations made This should be compared with a similar registration of another plot of wheat sown on clean soil and soil that had not been manured and where there was neither suspicion of rusted stubble nor of hibernation from a previous wheat crop

By a series of such experiments, that might readily suggest themselves to any practical man, the danger of manure communicating the disease might be more or less conclusively determined

Burning Stubble *Conf with* [illegible]

75 ***Burning Stubble.***—Then again the point that has received very careful study *in* Australia does not so far as I can discover, appear to have been enquired into in India, namely, whether or not a system of thorough cleaning the fields by burning the stubble is or is not beneficial This would, therefore, seem to be a point well worthy of careful investigation

Rotation of Crops *Conf with* 1 p [illegible]

76 ***Rotation of Crops.***—Assuming that the disease hibernates in the soil in some form or other, there would naturally be a term of years beyond which it could not survive This is one of the

[illegible]

The [illegible] Wheat.

77 *Rust Shrivelled Seed.*—[illegible] Dr. Cobb [illegible], however, that "there is, of course, [illegible] have [illegible], but the question is whether this would apply to another generation."* At the same time the very strenuous [illegible] have been [illegible] in support of an advantage derivable from using for seed purposes carefully selected [illegible] grains. It would therefore seem desirable that experiments be instituted in India with the object of ascertaining whether the advantage claimed holds good in this country. It seems likely that from the annual prevalence of rust in certain tracts of country rust shrivelled seed must have been more or less constantly employed for centuries past. The question could not, however, be regarded as disposed of by general observations of that nature, since the admixture of a certain percentage of pure grain might easily enough nullify the advantage, if advantage there be in the use of rust shrivelled seed.

78 *Selection and Improvement of Seed.*—The greater climatic correspondence that exists between the area of wheat cultivation in Australia with that of India (than perhaps of any other part of the world), gives a value to India in the praiseworthy efforts that have been made in Australia to battle with the problem of wheat rust. Within the past few years the attention of the Australian experts seems to have been very largely diverted from the exploration of the life history of the fungus to the study of the wheat plant itself.

Improvement of Seed.

* Plate II, figs. 11 and 12.

F. 725.

III RUST on WHEAT
Rust-Resistant Stock

more liable to the disease than wheats that have never enjoyed any such immunity. It has, therefore, been admitted (in countries where the question of rust-resistance has been investigated) that it is necessary not only to develop a rust resistant stock for each wheat area of its own, but to be prepared periodically to substitute a new stock, after the lapse of so many years, otherwise a serious calamity may result from the stock being found to have lost its property of rust-resistance

Mr. W M. Farrer of New South Wales has given the subject of rust resistance very careful study, and his results seem to give promise of being of the very greatest value to the Australian Colonies It may not, therefore, be out of place to give here a passage from one out of the numerous papers, reports and lectures which he has published on this subject that seems to fairly represent his views —

"The main cause of the rust fungus being able to gain a hold of the wheat plant is a soft, pulpy, succulent condition of its outside tissues at the time when the rustspores are abroad This soft condition is either a normal characteristic of the variety itself, or is induced in some varieties by the environment-conditions which happen to prevail during the susceptible stage of their growth These environment-conditions, which I shall include under the term "rusty weather," are the presence of much *moisture in the soil, with a moist and still condition of the atmosphere,* accompanied by much heat

Rusty Weather.

Varieties that have for a normal characteristic straw and foliage, the outside coating of which is not close enough of texture and not well glazed with silicious matter are always liable to rust even in seasons that are little favourable to the parasite, while in rusty seasons they are sure to suffer severely, unless a habit of early maturity happens to have put them through the susceptible stage—has caused their tissues to become hard—before the rusty weather came on Other varieties, again, of a vigorous habit of growth are liable to surrender to the pest, even though their straw and foliage are of the right texture and well provided with a silicious coating, if they happen to be caught by rusty weather during the susceptible stage of their growth

Susceptible Stage

This happens more readily if they are growing in rich soil, and more readily still if their foliage is also broad and heavy Their vigorous habit then causes *them to respond too freely* to their stimulating environment, and by the aid of their abundant foliage they make a rapid and unseasonable growth of soft sappy tissue. Such tissue can offer little resistance to rust For *cold and cloudy countries like England,* where evaporation is slow a broad flag is needed to evaporate all the water the plant requires for its growth, and to catch sunlight enough to elaborate the sap and mature the seed but in *sunny countries like our own,* a broad flag is not wanted, and becomes a source of danger in rusty weather The possession, then,

Broad Leaves undesirable in India.

III RUST on WHEAT. Rust-Resistant Stock.

of straw and foliage, the outside coating of which is of too soft and open a texture and deficient in silicious matter, a too vigorous habit of growth, and a broad heavy flag, are all characteristics that cause a wheat to be unsuited to our conditions where rusty weather so often occurs during the susceptible stage of the plant's growth

Vigorous Growth.

"Before I go further I would wish to devote further discussion to what I have just been trying to point out, that a variety of wheat which is of vigorous growth, is on that account ill adapted to our conditions; but in doing this, I would wish it to be understood that I make an exception of the Durum series of wheats—of the varieties of Triticum durum. These wheats, although their growth is vigorous, have wiry straw, and foliage of peculiar texture, and being natives of hot countries, possess constitutional characteristics which cause them to thrive well and to offer a high degree of resistance to rust in our climate I will also make a partial exception of the Poulard wheats, which are varieties of Triticum turgidum. These wheats have straw that is well glazed and more or less solid Like the Durums, they are natives of hot climates, but their foliage appears to be heavier and their growth somewhat less vigorous. They, too, *resist rust fairly well in our climate* Both the *Durum* wheats, however, and the Poulards, unfortunately possess other characteristics which are undesirable, and we ought to do without them if we can get or make others of better milling quality to take their place, and that I think we can do

Poor Milling Quality

Dwarf Growth in Hot Countries.

"I have been much struck by the fact that, with the exception of the Durums and the Poulards, and one or two varieties which seem to contain Durum or Poulard blood, all the numerous wheats I have had under trial from hot countries have been of a moderate and sometimes even of a dwarf habit of growth Such a habit is the one that would cause the plants possessing it to respond in the least degree by rapid growth to the stimulating conditions of heat combined with moisture, which are apt to prevail in hot countries during the susceptible stage of the plant's growth This moderate or dwarf habit has been brought about in hot-country wheats, I think, by a kind of natural selection operating through long periods of time, which has caused the weeding out of such plants as, in consequence of their vigorous growth, have been exposed to rust I have also noticed that of these moderate growing wheats, those resist rust the best that are the most scantily furnished with stiff, well glazed foliage I can give an illustration of this from our own wheats Of all the varieties of Australian origin which are in common cultivation, that which is the most lightly clothed with foliage is Ward's Prolific, and it is the one which has been found to be the most resistant of rust and the safest to grow, especially in the warmer parts of the country. Lightness of foliage, however, a habit of moderate growth, and fairly early maturity are the qualities which give to this variety all its value; but they are unfortunately associated with other characteristics which are the reverse of desirable. Experience, in short, confirms the conclusion which reason points to, that if we want to escape rust in our warm climate, we must

Desirable Conditions.

III. RUST on WHEAT. Rust-Resistant Stock

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III. RUST on WHEAT.

Rust-Resistant Stock.

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Dwarf Growth in Hot Countries.

Desirable Conditions.

III RUST on WHEAT

Rust-Resistant Stock

Inferior Milling Quality

grow varieties which possess, unless they have Durum blood in them, a habit of moderate, and even, in some parts of Queensland, of almost dwarf growth, and are lightly clothed with stiff, well glazed foliage. It is on account of the moderate growth of their wheats that hot climate countries have furnished us with almost all the resistant varieties that have come into our hands, but such varieties have been of inferior milling quality, and it is for that reason that all resistant wheats have come to be regarded with suspicion and the search after them to be disparaged. This inferiority for milling, however, is by no means a quality which is necessarily attached to all resistant wheats as such, but is largely accidental, and has arisen from the fact that in the countries from which we have derived such wheats, high milling quality has not been attended to or sought after to the extent it has been by us or in the more advanced countries of Europe and America. The only characteristic of the grain of resistant wheats which I consider to be essential is that it be hard, and that is in correlation with their hard and flinty straw. A hard grain is far from being undesirable. It can be dealt with effectively

Hard Wheats

by roller mills, it is generally rich in gluten, its bran is often very thin, and it is less likely to suffer from weevils.

"I ought not, perhaps, to leave this part of my paper without mentioning that another advantage which is often possessed by wheats of a moderate habit of growth, is that, like fruit trees of a similar habit, they appear to be more productive on that account. It is as if their strength,

Greater Yield

instead of being given to the production of more stalk and foliage, is used for adding to the production of grain.

Early Maturity

"Another characteristic which exposes wheats to rust is late maturity. Early maturity, while it can scarcely be said to enable wheats to resist the contagion, often causes them to have almost ceased to be susceptible to it before the advent of hot weather has caused the contagion to be abroad. Certain varieties which, like the Steinwedel, have gained a reputation for resisting rust, owe it entirely to their earliness, and in reality do not possess the qualities of a resistant wheat. Such varieties if they happen to be caught by rusty weather earlier in the season than is usual, or if they are planted late, or if for any reason they happen to be exposed to the contagion before they have passed through the susceptible stage, invariably become infected. Early maturity is a most desirable characteristic of resistant, as well as of wheats that are not resistant, and it should be secured whenever it is possible to do so, because it often enables the varieties possessing it to escape exposure to the contagion but it does not enable them to offer any resistance to infection if they happen to be exposed to the contagion before they have ceased to be suscept ... n r can any variety be considered ... grow on account of ... tu- rity alone, for hot weat ... liable to come on ea ... a- son than is usual, farmers ... be tied down too ... ir time of sowing, and early ... happen to be so to be exposed to the para ... ubstantial adv

possessed by early wheats is that they are likely to escape hot drying winds, which sometimes cause the grain to be almost as much pinched as does the rust On the other hand early wheats are liable, in a few exceptionally cold and late districts, to be caught by unseasonably late spring frosts while they are in bloom

"I will now recapitulate. The following are the special characteristics of wheats that are the most likely to resist rust in our climate —

"1 The straw and foliage should have a covering of close texture, and be well glazed with silicious matter.

"2 The habit of growth should be moderate, and for hot districts even somewhat dwarf, provided that such a habit is not the result of constitutional weakness

"3 The flag and foliage, in addition to being well glazed and of close texture outside, should be light, narrow, and stiff, the reverse of heavy, broad and flabby

"4 The grain should be hard.

"5 The time of maturity should be early

"The above, as far as I know at present, are the main characteristics which are required by wheats to be resistant of rust in this country, but any variety, in order that it may possess this quality in a high degree, must have associated with these qualities for one of its characteristics as a living organism, an indefinable quality which we can only call a constitutional resistance to the pest This is a quality which is largely hereditary, and can be secured and even greatly increased by the exercise of judgment in the choice of parents in the breeding of new varieties, but at the same time, it is a quality which is liable to be impaired, weakened, or even lost by the accumulated effects of a long course of carelessness, or of mistakes in the management or choice of seed-grain, as well as (what I have already on a former occasion attempted to point out) by too long continued in-breeding. These points can be embraced by a sixth requirement, which is—

"6 That the variety itself be not too old, and that it possess a constitution which causes it to be naturally resistant of rust and adapted to the conditions of the locality in which it is grown.

"In order that we may have before us the characteristics of an ideal wheat for our country, I will add to the above special characteristic of o resistant variety, the other points of an ideal high-class wheat They are—

"7. That the straw, in addition to being short or moderately short, and to having o covering of close texture and well glazed, be also stout, stiff, and wiry (not fleshy), and that the tillering stalks run up fairly straight and in a regular manner from the crown of the root Instead of spreading out irregularly as is the case with such varieties as the Clawson Stout, stiff straw, growing up straight and in a compact and regular manner, not only gives to the crop

III. RUST on WHEAT. Rust-Resistant Stock

Recapitulation

Constitutional Resistance Hereditary.

Adaptation.

Ideal High-class Wheat.

FUNGI	Commoner Rusts and Mildews

III RUST on WHEAT

a good appearance, but enables it to resist storms and heavy rains without being laid, and to stand up well before the stripper or reaper.

"8 That the head be long, close, and full, and so formed as to hold an abundance of grain, also that it be smooth (without beards)

"9 That the chaff lie close to the grain and cover it well, and be stiff and strong enough to hold it firmly and prevent it from shelling

"10. That the grain be bright, semi-transparent, heavy, plump, thin of bran, somewhat long rather than short or round, smallish or of medium size rather than large, that it have a shallow crease (a deep crease or furrow, harbours dirt and increases the proportion of bran), a rounded germ which should not be prominent enough to be exposed to injury in thrashing, and a fine brush as indicative of high quality, and lastly—and this is of the very greatest importance—that it be rich in gluten, which should be of fine texture The colour of the grain is immaterial, for it is the bran which gives its colour to the berry, and the bran is separated from the kernel and got rid of by roller mills before the grinding or crushing of the kernel begins As a matter of fact, however, the wheats that are the best for milling (the most nutritious—the richest in gluten) are mostly red and lastly—

Rich in Gluten

"11 That the variety itself be productive enough in soil of average fertility and without the aid of manure, to be profitable to the farmer, that it have the habit of tillering well, of ripening its grain evenly, of bearing its ears at a uniform height, and of not producing late suckering shoots

Peculiarities of Rust-Resistant Wheats

83 ***Microscopic Peculiarities of Rust-Resistant Wheats.***—Acting on Mr Farrer's practical observations and results Dr Cobb has done most admirable service by carefully investigating the microscopic structure of the leaves of the rust resistant as compared with the rust liable wheats For this purpose he examined in each case, the three top leaves of plants in full bloom He found that the penultimate leaf, measured near the middle, varied so very slightly in each species (or race) of wheat that the measurements might be taken, at this position and age, as characteristic of the form He gives the results of his comparative studies of some 30 forms of wheat in which the thickness of the penultimate leaves taken at the middle, range from 193 mm to 239 mm "In other words, the leaves of two wheats may differ as much from each other in thickness, roughly speaking, as a three quarter inch plank differs from an inch plank" He next directed attention to the study of the cuticle of these wheats as seen on thin transverse sections It was observed that in rust resistant wheats the cuticle was more than twice as thick as in rust liable wheats The idea was thereby suggested that this fact might be directly connected with rust resistance It was also noted

Measurement of Leaves

III RUST on WHEAT

Influence of Thick Cuticle

that the cuticle of the *under surface* of the leaf was thicker than that of the *upper-surface* It was next recorded that the under-surface of the leaf, as a rule, escaped infection of rust From these considerations it was inferred that "the structure of the cuticle in a variety of wheat has a most important influence in determining its liability to rust." It was suggested that this might be owing to either of two considerations—*first*, the cuticle might be so constructed as to prevent the entrance of rust, *second*, it might be so constructed as to imprison the rust when it had gained admission to the tissue of the leaf That is to say, the thick cuticle might resist the escape and dissemination of uredospores. The question as to whether a thick cuticle did actually offer resistance was next investigated and by a simple contrivance it was shown conclusively that thick cuticle was associated with a high tensile strength In other words, that the leaves of rust-resistant wheats had not only thick cuticles, but were also very tough.

Peculiarities of Rust-Resistant Wheats

84 Turning his attention to the question of the number and size of the breathing mouths (stomata) Dr Cobb found other facts that bore a remarkable correlation to the observations as to thickness and toughness of the cuticle. "In general, he says it may be said that on resistant wheats the stomata were found to be smaller and more numerous, while on nearly all the leaves the number of stomata was fewer by about 10 per cent on the lower surface than on the upper Nevertheless the smallest stomata observed were large enough to admit the entrance of the promycelial thread of rust"

Small Stomata

85 Speaking of the subject of the glaucous bloom (already alluded to), Dr Cobb remarks —'We made a most interesting observation on a hitherto unkown function of the waxy covering so characteristic of certain wheats, especially when young This wax or bloom gives to the plants on which it occurs a glaucous whitish, or even white-washed, appearance, according to its abundance Its function already long since known, is the same as that of the wax covering or bloom on grapes, certain apples and many varieties of foliage, namely, to protect the plant from the injurious action of water We discovered, however, *that it had no small influence in keeping out the promycelium of rust*" Dr Cobb proceeds to show how this is accomplished In leaves coated with this bloom it is often very difficult to see the stomata They exist as narrow slits in the wax Leaves of this nature were submitted to careful examination Spores of rust were placed on them and their germinating tubes watched with the utmost precision They were witnessed to crawl across the stomata without discovering an entrance into the leaf "These observations explain in a remarkably clear manner why the sheath and straw of glaucous wheats often remain for a long time quite free from rust although the flag may be quite rusted The flag, especially the upper surface, is usually much less glaucous than the sheath It is noticeable that the resistant wheats, as a rule (there are marked exceptions), are wheats possessing a glaucous character"

Glaucous Waxy Exudation *Conf with pp 30 42, 6.*

FUNGI	Commoner Rusts and Mildews

III RUST on WHEAT Glabrous Wheats

The observation very commonly made that rust-liable wheats are very frequently glabrous, that is to say not hairy, led to an enquiry into whether selection towards the production of hairy wheats would give protection against rust. The result may be said so far to have been negative, though as pointed out by *Dr Cobb*, should the hairs be so long as to prevent the promycelium from reaching the surface of the leaf, hairiness to that extent would doubtless afford a certain amount of protection The hairiness of rust-resistant wheats may more likely be an accidental association with thickness of cuticle—the more direct cause of immunity from the disease

Enough has perhaps been quoted, from the admirable and praiseworthy investigations that have been and are being prosecuted in Australia, to show that by careful selection and crossing of races, it is highly probable the great question of the solution of wheat-rust may be attained by the production of races of the plant that give sufficient immunity from the disease to remove all further anxiety.

Acclimatisation of Wheats

86. ***Acclimatisation of Wheats in India.***—The account of wheat cultivation in India, as given in the Dictionary of the Economic Products, may be said to have established the unsatisfactory nature of the results obtained in the efforts to directly acclimatise foreign wheats in this country It is there observed that it has long been held by Native cultivators all over India that the colour and consistence of wheat are more dependent upon climate, soils, and surrounding conditions in general, than on the original stock from which the race is derived. Thus in many official reports from the Panjab, North-West Provinces, Central Provinces and Bengal, as well as Bombay, the statement is commonly made that a soft white wheat, removed from its own locality to another in which the grains grown are hard and red, tends to change its physical characters, to become hard and to turn red in colour That is to say, foreign wheats assume, to a certain extent, the characters of the crops prevalent in the district to which they are introduced This will, therefore, be seen to emphasise the force of the statement made above that in all attempts that may be put forth with a view, either to improve the quality of the wheat grown, or to produce a rust-resistant stock, the experiments must be performed in the district in which the wheat is ultimately intended to be cultivated. Further that acclimatisation pure and simple, without any rational process of selection and crossing, must of necessity prove futile.

Change of Colour.

Local Experiment necessary. *Conf with p 60*

An extensive series of reports on wheat experiments exists in the publications issued by the Director of Land Records and Agriculture, Bombay. The results may briefly be said to have been highly unfavourable and the Director commenting on the experiments performed in Sind concludes by saying, " It is questionable whether there is any use in attempting the growth of foreign wheats The Indian varieties supply ample material for improvement ' With the last sentence I entirely concur, but so far I do not find that any real steps have been taken toward improvement of the indigenous stock and therefore the recommendation that selection on the lines of rust-resistance would seem a matter of vital importance to this country — III RUST on WHEAT

87 ***Annual Losses from Fungoid Blights.***—The annual loss from wheat rust in India is very probably not far short of ten times the figure that it will be found **Dr. Barclay** (p 88) estimated, viz , ten instead of one per cent In the Australian colonies the annual loss from rust has been variously stated at from £2,000,000 to £3,000,000 It is probable that the wheat area of Australasia does not come to 5 000,000 acres or say less than one fourth that of India The wheat acreage of the United States is about twice that of India, and of Europe about 95 million acres—the total wheat area of the world being a little under 200 million acres In the Annual Report of the Department of Agriculture (United States) for 1892 (p 216) it is estimated that rust causes a uniform loss of 2 bushels an acre, or a total of 80 000 000 bushels, which at the market rates of 1891 would have come to $67 000 000 These two estimates (the Colonial and the States) would thus seem to conflict with each other, unless it be the case that Australia suffers from rust to a far greater extent than any other country in the world The Australian figure stands, however, a considerably greater chance of being correct than the American, for the reason that hitherto very much more attention has been given in the Colonies to the subject than in the States But in every country the greatest possible difficulties are experienced in framing estimates of losses from rust The disease varies so much from year to year and from field to field, that no actual data of the total loss can be produced The estimates mentioned show, however, that the world s annual loss of wheat from this cause must be very great indeed India is by no means an exception to the conditions that prevail in other wheat-producing countries, and an

Losses from Fungoid Diseases. *Conf with p 88.*

In Australia.

In the United States

In India.

FUNGI. | Commoner Rusts and Mildews

III RUST on WHEAT.

Losses from Fungoid Diseases

annual loss of 10 per cent is very probably under rather than over the mark

It seems, indeed, probable that were a careful estimate to be made of India's losses from fungoid blights of all kinds, it might be found to assume a figure something like £10,000 000 sterling a year But this statement is made upon personal impressions not actual data I should not, for example, be surprised to find that the loss sustained by the Tea Planting industry from these causes alone came to close on 10 per cent of the possible outturn The Ceylon Coffee industry was ruined by a fungus, the annual loss having been for some years at the rate of £2,000,000 sterling I have seen many miles of country where the leaves of the *juar* were literally red from rust or the spikes black with smut The annual loss of grain in that crop is probably not far short of from 5 to 20 per cent over the whole country The linseed crop is yearly affected to an extent of from 10 per cent. to 50 per cent and it is by no means an unusual occurrence to find the crop entirely ruined The Indian corn crop is often smutted to an alarming extent Whole fields of *tur* (Cajanus indicus) are not infrequently seen withered up and dead through what appears to be a root fungus The injury to the Silk industry through the diseases known as MUSCARDINE (Botrytis bassianæ), PEBRINE, and FLACHERIE is in India very considerable The first mentioned is undoubtedly a fungus and the others are by most writers believed to be of fungoid origin

But enough has perhaps been said to justify the statement that the agricultural losses India sustains from these diseases alone are greater than from all other annually recurring calamities taken conjointly The climatic theory of their origin—a theory that gave birth to a spirit of apathy or rather of resignation—can no longer be entertained They are plants that doubtless become more prevalent under certain conditions than others but favourable climatic conditions without the existence of the germs could never produce the diseases due to these fungi They can be battled with, therefore, on lines that have been found in other countries to at least afford protection from ruinous losses It is to be deplored that so far absolutely nothing has been done in this country toward the mitigation of these c Experiments at acclimatisation of new or improved races of cro have claimed an army of supporters, and large sums, comparativel

III RUST on WHEAT.

speaking, have been fruitlessly expended on these, while nothing has been done with the avowed object of ameliorating the agricultural depression that might in all fairness be attributed to the losses caused by fungoid diseases of crops.

58. Publications that may be consulted—

A very extensive library of works might be quoted on the subject of wheat rust, but confining attention to those of a more direct agricultural interest and also of, comparatively speaking, recent date, the following may be quoted:—

1. Wheat Mildew by Dr. W. Carruthers, *Journal, Royal Agricultural Society, England, Volume XVIII (Second Series), 1882, pp. 495-503.*
2. Rust and Mildew on Wheat, *Board of Agriculture, London, 1892.*
3. Rust or Mildew on Wheat, *Journal, Board of Agriculture, London, December 1894*
4. Experiments in Treatment of Wheat Rust, *Annual Report, Secretary, Agriculture, United States (1892), pp. 210-224.*
5. Presidential Address, 1891 (Dr. Goodale), to the American Association for the Advancement of Science
6. Wheat-growing in Queensland by Professor E. M. Shelton, *Bulletin No. 19 of 1892 in Annual Report of Department of Agriculture, Brisbane, 1891-92.*
7. The Agricultural Gazette of New South Wales, *Volume I. (1890), pp. 41-43, 73-75, 81-92, 185-214, II. (1891), 403-4, 729-30, III. (1892), 44-68, 181-212*
8. The Reports of Rust in Wheat, *Intercolonial Conferences, I., II., III. and IV.*

III RUST on WHEAT.

Losses from Fungoid Diseases

annual loss of 10 per cent is very probably under rather than over the mark

It seems, indeed, probable that were a careful estimate to be made of India's losses from fungoid blights of all kinds, it might be found to assume a figure something like £10,000 000 sterling a year But this statement is made upon personal impressions not actual data. I should not, for example, be surprised to find that the loss sustained by the Tea-Planting industry from these causes alone came to close on 10 per cent of the possible outturn The Ceylon Coffee industry was ruined by a fungus, the annual loss having been for some years at the rate of £2,000,000 sterling I have seen many miles of country where the leaves of the *juar* were literally red from rust or the spikes black with smut The annual loss of grain in that crop is probably not far short of from 5 to 20 per cent over the whole country The linseed crop is yearly affected to an extent of from 10 per cent. to 50 per cent, and it is by no means an unusual occurrence to find the crop entirely ruined. The Indian corn crop is often smutted to an alarming extent Whole fields of *tur* (Cajanus indicus) are not infrequently seen withered up and dead through what appears to be a root fungus The injury to the Silk industry through the diseases known as Muscardine (Botrytis bassianæ), Pebrine, and Flacherie is in India very considerable The first mentioned is undoubtedly a fungus and the others are by most writers believed to be of fungoid origin

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IV
TAKE-ALL

b "Take all sometimes appears one season on a spot which is free from it the following season

c The outward appearance of the soil where Take all occurs is generally similar to that of adjacent soil where it does not occur

d "Take all very often appears on badly drained soils, but not always

e "Take all may appear on the very best cultivated lands

f. It occurs in patches and each patch generally of no great extent, a fact that points to a definite disease

g Dr Cobb observed that the plants affected by this disease dried up when young mysteriously, and moreover in nearly all well attested cases of 'Take all he found the wheat to be infested by two fungi namely, Cladosporium herbarum and Septoria graminum

h Each of these fungi he tells us are readily recognized by the aid of a good lens Septoria causes the affected parts to turn first yellowish green then yellow and finally to dry up and to assume the colour of ordinary dead grass

i If these withered portions be more carefully examined, characteristic minute black spots appear under the skin or cuticle These are the fruits of the fungus and each will be found to contain hundreds of elongated spores

j Sometimes only portions of the leaves will be seen to have withered and spotted as above and it is necessary to record this fact since the second fungus may be found on the same leaf Instead of forming round spots underneath the cuticle, the fruiting pustules of Cladosporium are generally arranged in lines and are composed of minute stalks which grow out from the surface of the leaves

k But Septoria does not confine itself to the leaves above ground, it very frequently appears on the sheath just above ground and in that case proves fatal to the plant A transverse section of the young wheat plant will reveal the fact that all the leaves and embracing sheaths have been attacked, and when this is the case nothing can save the plant

l Cladosporium may also occur on any part of the plant host, but it presents very different appearances on the different plants or even different parts of the same plant. It consists of fine mycelial threads growing both inside and on the surface of the wheat or other hosts The external portions are dark olive green and are seen to bear

CHAPTER IV

A FUNGOID BLIGHT THAT WOULD APPEAR VERY PROBABLY TO EXIST ON INDIAN CROPS

XII —TAKE ALL and DRY BLIGHT

89 At the Intercolonial Wheat Rust Conferences held in Australia repeated reference has been made to a disease described by the farmers as "take all" Mr Pearson of Victoria, in his address to the Conference held in Sydney in June 1891, alluded to this disease and Dr. Cobb expressed a desire to hear more about it Mr Pearson explained that it was "a disease which appeared in a crop, and destroyed everything growing around certain spots leaving nothing but bare patches of earth He was of opinion that it might be due to a variety of causes, one cause seemed undoubtedly to be a fungus which attacked its roots Such a fungus was first described by Dr Carl Mucke in his prize essay on 'Take all, published by the South Australian Government In that essay Dr Mucke gave drawings of the fungus, which, however, were not satisfactory, and he also stated that Baron von Mueller had named the fungus Xenodochium cerealium." Mr Inglis, of South Australia said he could remember "take all" in his colony for the past twenty five years It attacked any kind of land and happened as often in crops grown on virgin soil as in cultivated land Dr Cobb explained that he had asked the question simply in order to obtain information as he had himself been studying the disease for some time past These facts, therefore, show the disease to occur pretty generally in Australia

Passing over a fairly extensive series of papers and reports on this subject that will be found in the proceedings of the Intercolonial Conferences, we come to a paper by Dr Cobb which he characterises as a "preliminary notice" but which contains much interesting information on the subject [see Agricultural Gazette, New South Wales, Vol III (1892) pp 991-1000]

The following passages taken from Dr Cobb's paper may be said to give the chief ideas which have been brought to light regarding this disease —

a The wheat suffering from "Take-all" makes a start and sometimes grows to a considerable height before dying off

V. INDIAN UREDINEÆ.

cannot be added since the Fditor is aware that most of these had been worked up and his notes on them were in a good few cases ready for publication at the time of his death

The figures, given within brackets (in the following list) denote the publications and pages detailed above —

1. Æcidium Aquilegiæ, *Pers* ? found on Aquilegia vulgaris (*7 page 226*)
2.* Æ. brevius, *Barclay*, on Pinus excelsa (*G pp 102-4*).
3.* Æ Cedri, *Barclay*, on Cedrus Libani, var Deodara (*2 also G p 104*).
4.* Æ. complanatum, *Barclay*, on Pinus longifolia (*G p. 101*)
5. Æ. Compositarum, *Martins*, on Myriactis nepalensis (*4 p 373*)
6.* Æ Cunninghamianum, *Barclay*, on Cotoneaster bacillaris (*7. p 224*)
7.* Æ. esculentum, *Barclay*, on Acacia eburnea (*8 pp 1 4*)
8.* Æ. flavescens, *Barclay*, on Senecio rufinervis (*7. p 226*)
9.* Æ infrequens, *Barclay*, on Geranium ? nepalense (*G. p 105*)
10.* Æ. Jasmini, *Barclay*, on Jasminum humile (*4 pp 363 4*)
11. Æ. leucospermum, *D C* ? on Anemone rivularis (*pp 361 2*)
12.* Æ. Mori, *Barclay* (=Cæoma Mori, *Barclay*), on Ficus palmata (*7 pp 225-6*)
13.* Æ orbiculare, *Barclay*, on Clematis grata, C orientalis and C. puberulata (*7 p 227*)
14.* Æ. Piceæ, *Barclay*, on Picea Morinda (*3 also G p 104*)
15.* Æ. Plectranthi, *Barclay* on Plectranthes Coetsa (*G pp 104 5*)
16.* Æ Saniculæ, *Barclay*, on Sanicula ? Europœæ, (*L 4 p 352*)
17.* Æ. Strobilanthis, *Barclay*, on Strobilanthes Dalhousianus (*4 p 369, also 13*) Conf with Puccinia Pollinæ below
18. Æ. Thalictri flavi, *D C* ? on Thalictrum Javanicum (*4 p 362*)
19. Æ. Thomsoni, *Berk*, on Picea Morinda (*1 also G p 104*)
20.* Æ. Urticæ, *Schum* var Himalayense, *Barclay*, on Urtica parviflora (an edible species) (*12 also 4 pp 368 9*)
21.* Æcidium on Rhododendron campanulatum (*18. See also foot note on opposite page*)

Cæoma Mori, *Barclay*, see Æcidium Mori, *Barclay* (No 13) above, found on Morus alba *L.* var serrata (*G p 97*)

C. Smilacis, *Barclay*, on Smilax aspera (*G p 95, also 14*) Corrected to Puccinia Prainiana which see below

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22.* Chrysomyxa Himalense, *Barclay*, found on Rhododendron arboreum (*G p 93, also 17*)
23.* C. Piceæ, *Barclay*, found on Picea Morinda (*G p 94*)

* New species and varieties, described by Dr Barclay in the above publications have been marked thus*

FUNGI.	Commoner Rusts and Mildews
V INDIAN UREDINEÆ	
8.	Æcidium esculentum, *Barclay*, on Acacia eburnea, *Jour, Bombay Nat. Hist Soc, Vol V, 1890*
9.	Some Rusts & Mildews in India, *Journal of Botany, Vol 28, pp. 257-261, Sept 1890*
10.	Some Rusts & Mildews in India, *Journal of Botany, Vol. 30, pp 1 8 and 40-49, Jan and Feb 1892*
11.	Puccinia Geranii silvatici, *Karst*, var himalensis, *Barclay, Annals of Botany, Vol V, No XVII, Dec 1890*
12.	Æcidium Urticæ, *Schum*, var himalayense *Barclay Scientific Memoirs, Medical Officers of Army in India, Pt II 1886*
13.	Æcidium Strobilanthis, *Barclay*—a Uredine on Strobilanthes Dalhousianus, *Sc Mem Med Officers of Army in Ind, Pt II, 1886*
14.	Cæoma Smilacis, *Barclay*, on Smilax aspera, *'Sc Mem. Med. Officers of Army in Ind, Pt IV, 1889*
15.	Puccinia Collettiana, *Barclay*—a Uredine on Rubia cordifolia, *Sc Mem Med Officers of Army in Ind, Pt V 1890*
16.	Gymnosporangium Cunninghamianum *Barclay, Sc Mem Med Officers of Army in Ind Pt V, 1890*
17.	Chrysomyxa Himalense, *Barclay*—a Uredine on Rhododeodron orboreum, *Sc Mem Med Officers of Army in Ind, Pt. V, 1890*
18.	Uredo * on Rhododendron lepidotum and an Æcidium on Rhododendron campanulatum, *Sc Mem Med Officers of Army in Ind, Pt VI 1891*
19.	Puccinia Prenanthes, *Pers* var himalensis, *Barclay*, and P Prainiana, *Barclay, syn* Cæoma Smilacis,—Two autœcious Cœmata, *Sc Mem Med Officers of Army in Ind, Pt VI, 1891*
20.	Uromyces Cunninghamianus, *Barclay*, on Jasminum grandiflorum, *Trans Linnean Soc, Vol III, Pt II, 2nd Series p 141, 1891*
21.	Puccinia coronata, var Himalayensis *Barclay*, on Rhamnus, and P. Jasmini Chrysopogonis *Barclay*, on Jasminum humile and Chrysopogon Gryllus, *Trans Linn Soc, Vol III (2nd Series) Pt. 6, pp 227 242 1891.*

INDIAN UREDINEÆ

It may serve a useful purpose to bring together Dr. Barclay's labours in the form of as complete an enumeration (alphabetically arranged) as may be possible of all the species of Uredineæ examined and described by him The attempt will also be made to refer all the particulars of each species to the position he finally determined it should occupy It is unfortunate that a further list of something like 20 new species, collected shortly before his death,

* During our last botanical excursion together, I found an Æcidium on Rhododendron lepidotum which Dr. Barclay said solved the mystery regarding these two species. He never lived to publish the result —EDITOR

of Indian Crops (A Barclay)	FUNGI
51 P Circææ, *Pers* on Circæa alpina (5 *p* 235)	V INDIAN UREDINEÆ
52 * P Collettiana *Barclay*, on Rubia cordifolia (15)	
53 * P coronata, *Corda* var Himalayensis, *Barclay* on Rhamnus davuricus (4 *pp* 358 9), on Brachypodium sylvaticum (5 *p* 248) and on Bachypodium and Rhamnus (21)	Conf with 1 P 48 109 115
54 * P crassa *Barclay*, on Pimpinella Griffithiana (7 *p* 210)	
55 P dolons, *Spreg* ? on Erigeron alpinus var multicaulis (7. *p* 218).	
56 P Ellisii, *De Toni* ? found on Angelica glauca (7 *p* 215)	
57 * P Eulaliæ, *Barclay*, found on Pollinia japonica (7 *p* 216)	
58 * P. excelsa, *Barclay*, on Phlomis lamiifolia (7 *pp* 216 7)	
59 * P Fagopyri *Barclay*, found on Fagopyrum esculentum (6 *p* 107 *also* 9 *p* 5)	Conf with pp 115 116
60 P flosculosorum, *Alb et Schw* found on Taraxacum officinale (5. *p* 238)	
61 * P Fragariæ, *Barclay*, found on Fragaria Vesca (4 *pp* 359 61, *and* 5 *p* 244)	Conf with pp 116 117.
62 P Galii *Pers* found on Galium aparine (5 *p* 239)	
63 P Gentianæ, *Strauss* found on Gentiana Korroo (6 *p* 108)	
64 * P Geranii silvatici, *Karsten*, var himalensis, *Barclay* (5 *pp* 236 7 *and* 11)	
65 P graminis, *Pers*, on Berberis aristata (4 *pp* 367 8), on Festuca gigantea (5 *pp* 249 50, *and* 10)	Conf with pp 90, 85 99 and 118
P helvetica *Schrt* (5 *p* 241) subsequently referred to P Collettiana which see sp 54 above	
66 P Iridis, *D C* found on Iris florentina and I pallida (6 *p* 105)	
67 * P Jasmini Chrysopogonis, *Barclay*, found on Jasminum humile and Chrysopogon gryllus (conf with P Chrysopogi above) (21)	Conf with pp 119 121
68 * P Leptodermis, *Barclay*, found on Leptodermis lanceolata (6 *pp* 86 *and* 109) Conf with Melampsora Leptodermis	
69 P Menthæ, *Pers*, found on Origanum vulgare (5 *p* 242)	
70 * P nitida, *Barclay* found on Polygonum amplexicaule (6 *p* 107)	
71 * P Penniseti, *Barclay*, found on Sorghum vulgare and Pennisetum typhoideum (7 *p* 215) non P Sorghi (9 *pp* 1 2)	Conf with pp 35 82, 124 125.
72 P Pimpinellæ, *Strauss*, found on Pimpinella diversifolia (4 *pp* 356 8 *and* 5 *p* 244)	
P Polliniæ, *Barclay* found on Pollinia nuda (4 *p* 359 *and* 5 *p* 243 *also* 13) Conf with Æcidium Strobilanthis sp No 17 above	
73 * P Prainiana, *Barclay* (*syn* Cæoma Smilacis, *Barclay*) found on Smilax aspera (19 *p* 3)	
74 * P Prenanthes *Pers* var himalensis *Barclay* found on Prenanthes Brunoniana and Lactuca macrorhiza (19)	
75 P pulvinata, *Rabenh* ? found on Echinops niveus (7 *p* 219)	
76 * P Rosæ, *Barclay* found on Rosa macrophylla (5 *p* 233)	Conf with p 126
77 * P Roseææ, *Barclay*, found on Roscœa alpina (5 *p* 237).	
78 P Rubigo vera, *D C* on wheat (9 & 10) Conf also with Uredo Ehretia sp 93 below	Conf with pp 45, 90 99

FUNGI.	Commoner Rusts and Mildews
V. INDIAN UREDINEÆ *Conf with pp 90-100*	*24.* Coleosporium Campanulæ, *Pers*, on Campanula colorata (*6. pp. 90-1*)
	*25.** C. Clematidis, *Barclay*, found on Clematis montana and C. Buchananiana (*6. pp 89 90*).
	*26.** C Plectranthi *Barclay*, found on lectranthes Gerardianus (*6p. 89*).
	*27.** Gymnosporangium Cunninghamianum, *Barclay* (*16. also 6. p 92*). Described originally as G. Clavariæforme, *Jacq.* ? (*4. pp. 370 1*) Found on Pyrus Pashia and Cupressus torulosa
	28 Melampsora æcidioides, *D C* ? on Populus alba (*7 p 223*)
	*29.** M ciliata, *Barclay*, on Populus ciliata (*7 p 223*).
Conf with p. 100	M. Leptodermis, *Barclay*, on Leptodermis lanceolata (*6 pp. 86-9*) Conf. with Puccinia Leptodermis, *Barclay*, below
Conf with p 100	*30.* M. Lini, *Pers*, on Linum usitatissimum (*9 p 3*).
	*31.** M Sancti Johannis, *Barclay*, on Hypericum cernuum (*6. pp. 84-6*).
	32 M. Salicis-Capreæ, *Pers* ? found on Salix sp. (*6. p. 88*).
	*33.** Monosporidium Andrachis, *Barclay* (*Genus et sp. nov*), on Andrachne cordifolia (*4. pp. 371-3*).
	34 * M. Euphorbiæ, *Barclay*, on Euphorbia cognata (*4. pp. 364-7*)
	*35.** Phragmidium incompletum, *Barclay*, on Rubus paniculatus (*p 83*)
	*36.** Ph. Laceianum, *Barclay*, on Potentilla argyrophyllum (*7. p 220*).
	*37.** Ph. nepalense, *Barclay*, found on Potentilla nepalensis (*7. pp. 220-1*)
	*38.** Ph. octoloculare, *Barclay*, found on Rubus rosæfolius (*7. p 221*).
	39 * Ph quinqueloculare, *Barclay*, on Rubus biflorus (*6 p 82*).
	40. Ph Rubi, *Pers* ? found on Rubus lasiocarpus (*6. pp. 81-2*)
Conf with p 101.	*41.* Ph subcorticum, *Schrank*, found on Rosa moschata (*6. pp 79-81*).
	42 Puccinia Acetosæ, *Schum*, found on Rumex nepalensis (*5. p. 240*)
	43. P Andropogi, *Schw*, on Andropogon tristis (*5 p 246*).
	44 * P. Anthistiriæ, *Barclay*, on Anthistiria anathera (*5. p 246*)
	45. P. argentata, *Schulz* ? on Impatiens amphorata (*6. pp 106-7*).
	*46**. P. Arundinellæ, *Barclay*, found on Arundinella setosa and A. Wallichii. [(*5 p. 245*).
	47. P Caricis, *Schum*, found on Carex setigera (*5. p. 244*)
	*48.** P. Caricis filicinæ, *Barclay*, on Carix filicina (*5. p. 250*).
	49 P. Castagnei, *Thüm*, on Apium graveolens (*7 pp 215-6*).
	*50.** P. caudata, *Barclay*, found on Stellaria paniculata (*7 p. 219*).
	P. Chrysopogi, *Barclay*, on Carysopogon gryllus (*5. p 247*); Conf. with P. Jasmini-Chrysopogonis below

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of Indian Crops (*A Barclay*) | FUNGI.

V. INDIAN UREDINEÆ.

51. P. Circææ, *Pers*, on Circæa alpina (5 *p* 235)

52.* P. Collettiana, *Barclay*, on Rubia cordifolia (15.).

53.* P. coronata, *Corda*, var. Himalayensis, *Barclay*, on Rhamnus davuricus (4 *pp*. 358-9), on Brachypodium sylvaticum (5. *p*. 245), and on Bachypodium and Rhamnus (21) — Conf. with 1 p 48, 102-115.

54.* P. crassa, *Barclay*, on Pimpinella Griffithiana (7 *p*. 219).

55. P. doloris, *Spreg* ? on Erigeron alpinus, var. multicaulis (7. *p*. 218).

56 P. Ellisii, *De-Toni* ? found on Angelica glauca (7 *p* 215).

57.* P Eulaliæ, *Barclay*, found on Pollinia japonica (7. *p* 216).

58.* P. excelsa, *Barclay*, on Phlomis lamiifolia (7. *pp* 216-7)

59.* P. Fagopyri *Barclay*, found on Fagopyrum esculentum (6. *p*. 107, *also* 9. *p*. 5) — Conf with pp. 115-116.

60 P. flosculosorum, *Alb et Schw*, found on Taraxacum officinale (5. *p* 235).

61.* P. Fragariæ, *Barclay*, found on Fragaria Vesca (4. *pp* 359-61, *and* 5. *p*. 244) — Conf. with pp 116-117.

62 P. Galii, *Pers*, found on Galium aparine (5 *p* 239).

63. P. Gentianæ, *Strauss*, found on Gentiana Kurroo (6 *p* 108)

64* P. Geranii-silvatici, *Karsten*, var himalensis, *Barclay* (5 *pp* 236 7, *and* 11.).

65 P [illegible] (7-8), on Festuca [illegible] ed to P. Collettiana which see sp 54 above — Conf with pp 30, 85-99 and 118

66. P. Iridis, *D C*, found on Iris florentina and I pallida (6 *p* 105)

67.* P. Jasmini Chrysopogonis, *Barclay*, found on Jasminum humile and Chrysopogon gryllus (conf with P. Chrysopogi above) (21). — Conf with pp 119-124.

68.* P. Leptodermis, *Barclay*, found on Leptodermis lanceolata (6. *pp* 86 *and* 109) Conf with Melampsora Leptodermis.

69. P. Menthæ, *Pers*, found on Origanum vulgare (5. *p* 242)

70.* P. nitida, *Barclay*, found on Polygonum amplexicaule (6. *p* 107)

71.* P. Pennisetii, *Barclay*, found on Sorghum vulgare and Pennisetum typhoideum (7 *p* 215) non P Sorghi (9. *pp* 1-2) — Conf with pp 35 52, 124-125.

72. P. Pimpinellæ, *Strauss*, found on Pimpinella diversifolia (4. *pp* 356-8 *and* 5 *p* 244)

P. Polliniæ, *Barclay*. found on Pollinia nuda (4 *p* 369, *and* 5. *p* 243 *also* 13) Conf with Æcidium Strobilanthis, sp No 17 above

73.* P Prainiana, *Barclay* (*syn* Cæoma Smilacis, *Barclay*) found on Smilax aspera (19 *p* 3)

74* P Prenanthes, *Pers*, var himalensis, *Barclay*, found on Prenanthes Brunoniana and Lactuca macrorhiza (19)

75. P. pulvinata, *Rabenh* ? found on Echinops niveus (7. *p* 219).

76.* P. Rosæ, *Barclay*, found on Rosa macrophylla (5. *p* 233) — Conf. with p 126.

77.* P. Roscoeæ, *Barclay*, found on Roscoea alpina (5 *p*. 237)

78. P. Rubigo vera, *D C*, on wheat (9 & 10) Conf. also with Uredo Ehretia sp 93 below. — Conf. with pp 45, 96-99.

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FUNGI.	Commoner Rusts and Mildews
V INDIAN UREDINEÆ	*79.** P. Saxifragæ ciliatæ, *Baaclay,* found on Saxifraga ligulata, var. ciliata (*5. p 234*)
	*80.** P. Saxifragæ micranthæ, *Barclay,* found on Saxifraga micrantha (*7. p. 218*)
Conf with pp. 34, 127	*81.* P. Sorghi, *Schw*, found on Zea Mays (*7 p 214*) non P Sorghi, *w*, (=P Penniseti, *Barclay*), on Sorghum vulgare (*9. p 1*).
	*82.** P. urticæ, *Barclay,* found on Urtica parviflora (*5. p. 234, also 12. p 10*).
	83. P. usitalis, *Berk.?* found on Ranunculus hertellus (*7. p 217*)
	84. P. Violæ,† *Schum*, found on Viola serpens (*4. pp. 354-6, also 5. p 244*).
	*85.** P. Wattiana, *Barclay,* found on Clematis Gouriana (not C. puberula) (*6. p. 109*)
	*86.** Uredo Apludæ, *Barclay,* found on Apluda aristata (*6 p 99*)
	87. U. Argimoniæ, *D C*, found on Argimonia Eupatorium (*7. p 229*)
	*88** U. Bupleuri, *Barclay,* found on Bupleurum falcatum (*6 p 98*)
	*89.** U. Colebrookiæ, *Barclay,* found on Colebrookia oppositifolia (*7. p. 227*)
Conf with p 128	*90.** U Cronartiiformis, *Barclay,* on Vitis himalayana (*6. p 98*).
	*91.** U. Deutziæ, *Barclay,* found on Deutzia corymbosa (*6. p. 100*)
Conf with pp 40 128-129	*92.** U Ehretiæ, *Barclay,* found on a Boraginaceous tree Ehretia acuminata (*syn* E serrata) (*7. p 228*)
	93. U Eupatoriæ, *D C*, found on Potentilla Kleiniana (by misprint in original P. Kleinicura, *W. & B*) (*6. p 98*).
	*94.** U. Gomphrenatis, *Barclay,* found on Gomphrena globosa (*6. p 99*)
	*95** U Ichoocarpi, *Barclay,* found on Ichnocarpus frutesceos (*7 p 228*).
	*96.** U Ipomœæ, *Barclay,* found on Ipomœa hederacea (*7. p 228*)
	*97.** U Pileæ, *Barclay*, found on Pilea trinervia (*7. p 228*)
Conf with pp 49 51, 129	*98.** Uromyces Agropyri, *Barclay,* found on Agropyrum (*7 p 212*)
	99. U. ambiens, *Cooke,* found on Buxus sempervirens (*7. p 213*)
	*100.** U Cunninghamianus, *Barclay,* found on Jasminum grandiflorum (*6. p 76, and 20*)
	*101.** U McIntirianus, *Barclay,* found on Hemigraphis latebrosa (*6 p 79*).
Conf with pp 130-131	*102.* U Pisi, *Pers*, found on Cicer arietinum and Lathyrus sativus (*9. pp 4 5*)
	103. U pulvinatus, *Kalchb et Cooke,* found on Euphorbia hypericifolia var indica (*7. p 213*)
	*104.** U Solidaginis, *Barclay,* found on Solidago virgaurea (*6 pp 77-8*)
	*105** U Strobilanthis, *Barclay,* found on Strobilanthes Dalhousianus (*6 pp 78 9*)
	106. U. Valerianæ, *Schum*, found on Valeriana Wallichii (*4 pp. 352-5 and 6 p 77*)

† Found by me also on V. suaveolens and shown to Dr Barclay, shortly before his death: he thought it might possibly prove a new species.—EDITOR

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of Indian Crops. (*A. Barclay*) FUNGI.

V. INDIAN UREDINEÆ.

*107.** U Vignæ, *Barclay*, found on Vigna vexillata (*7. p 211*).
*108.** U. Vossiæ, *Barclay*, found on Vossia speciosa (*6. p 76*)

*109.** Xenodochus Clarkianus, *Barclay*, found on Astilbe rivularis (*7. p 212*)

It will thus be seen that out of 109 species of Uredineæ examined and described by Dr. Barclay, 72 were forms entirely new to science. When it is added that these fungoid diseases of plants were nearly all found within a radius of a few miles around Simla the immense unexplored field afforded by the vast plains of India may be realized

VI
WHEAT
RUST

CHAPTER VI.

CERTAIN INTERESTING PASSAGES FROM THE PUBLICATIONS ENUMERATED ABOVE (*pp 79 80*)

The following passages may now be quoted from Dr Barclay's writings, and with the exception of his detailed article on Wheat Rust the others will be found to be taken up in the sequence followed in the above enumeration —

Species Nos 65 and 78, page 83.

RUST AND MILDEW IN INDIA

BY THE LATE A. BARCLAY, M B, F L S

(PLATE II)

In the course of my studies, now extending over several years, on the group of parasitic fungi known to botanists as the Uredineæ, my attention has naturally been directed frequently to those species which attack cereal crops, and are so destructive of them Indeed as Mr H L Bolley writes in a recently published bulletin,* "There is, perhaps, among the numerous diseases of our cereal crops, not one that is, or can be, of more disastrous consequences to the farmer than the various species of rust which attack his field crops" Yet it is astonishing how little attention has been paid in India to this source, sometimes of enormous loss, and always, as appears probable, of considerable loss Other fungi have been the cause of immense and sometimes total destruction to other crops, *e g*, the vines, potato coffee etc, but although these have justly attracted much attention, I do not think any one of them can compare in importance with the rust, and mildew of cereal crops, both because a failure of the former crops (with the exception perhaps of the potato crop of Assam) withdraws only a direct supply of luxuries, which are not usually enjoyed by the actual producers, and because rust and mildew are a source of *constant* loss, and directly affect the staple article of food of the labourers in wheat producing areas We have, however, so far as I am aware, and I have looked carefully for information in every direction, not even the crudest approximate estimate of the geographical distribution of the pest in our wheat producing areas Still less have we any knowledge of the actual amount of loss sustained in the outturn of grain, either from attacked fields or from individual plants *Conf with p 71*

With regard to the geographical distribution of the disease, there can, I think, be no doubt that it exists wherever wheat is grown This statement is not a mere haphazard conjecture, but is based on the known distribution of the parasite in other parts of the world, and upon certain direct personal observations These latter are, of course few, as I have had neither the time nor the opportunity for extending them Such as they are, however, they will be set forth as soon as I have given reasons for believing that the fungus is prevalent in India wherever

* *Bulletin of the Agricultural Experiment Station of Indiana* H. L. Bolley, July, 1889

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wheat is grown, from its known distribution elsewhere. Thus we know it to be extensively prevalent throughout Europe and the United States. It is also known to occur over large areas in Australia, so much so that Professor F M. Webster, the American representative at the Australian Exposition, "informs us that in some of the colonies the raising of wheat, oats, and similar cereals has to be almost abandoned because of the prevalence of rust, where otherwise crops above the average could be produced"* The Director of the Agricultural Experiment Station of Indiana (Dr H E Stockbridge), who was lately in the service of the Government of Japan, states, "that in the northern part of that country, where the government has made costly and strenuous exertions to supplant rice culture by the growing of wheat, the latter crop is frequently utterly ruined, and on the average damaged to the extent of 20 per cent. by the very general prevalence of rust"† Dr. Frank ‡ says it is known in the Cape of Good Hope, and, indeed, that the fungus appears to accompany crops all over the world

VI. WHEAT Distribution.

From this alone we might safely assume that it is also extensively prevalent over India But there is some direct evidence pointing to this conclusion In the *Transactions of the Agricultural and Horticultural Society of India,* vol vi, 1839, Captain Sleeman reports the immense destruction of crops from it in the Narbadda Valley and through Malwa generally The particular epidemic he describes was unusually severe, and this periodic recurrence of severe epidemics is characteristic of the disease. Thus particular years of frightful destruction are known to have occurred in England, Germany, and America. It might, therefore, be supposed that during the intervals of such epidemics the pest is absent. This, however, is not the case elsewhere in the world, and is not the case in India. In 1887 Colonel Kenneth Mackenzie, Judicial Commissioner of Berar, informed me that he had *frequently* known rust to be so prevalent in that province, that in walking through fields his clothes were covered with red dust (the uredospores) Again, early in 1889, a year not known to be one of rust prevalence, I obtained specimens of well rusted wheat from such remote localities as Dumraon, Jeypore, and Gujrat, and later from Gilghit, while my personal observation of the fields about Simla for some years showed me that the wheat crops are annually enormously rusted and mildewed There can therefore, be no doubt in my mind that the parasite is widely prevalent, and that it *annually* gives rise to enormous loss

Narbadda Valley in 1839 *See opposite page.*

Always Present.

We may next proceed to attempt to guess the magnitude of the loss sustained in India in wheat alone, leaving out of consideration, the loss from other crops known to be similarly affected. In an interesting article on this subject, by Mr W. C. Little, in the *Journal of the Royal Agricultural Society of England,* he writes:—"Among the numerous diseases which affect the cultivated crops of this country, there is probably not one which is more disastrous to the

* H L. Bolley, *loc cit* See also *Gardeners' Chronicle,* June 7th, 1890, p 714, where it is noted, "It is estimated that a million of money has been lost this season in South Australia from the ravages of red rust"

† H L Bolley, *loc. cit*

‡ *Die Krankheiten der Pflanzen* : Breslau, 1880.

FUNGI.	Commoner Rusts and Mildews

VI RUST

Magnitude of Loss. *Conf with p 71,*

farmer than wheat mildew is in those parts of the country where it is frequently prevalent " He then goes on to estimate the actual money loss sustained by the farmers of the countries around Cambridgeshire, of whom he was one, in 1881, a year of great rust prevalence over a cultivated area of 15 000 acres, and writes —"If we estimate that throughout the districts of which I have spoken, the wheat crop was damaged to the extent of £4 an acre, we have an aggregate loss to the farmers of that district amounting to £60,000 on the wheat alone leaving out of sight the damage done to other crops " Mr. H. L. Bolley of the Agricultural Experiment Station in Indiana, writes * —"It is quite common for rust to be credited with damage equal to 50 per cent of the normal crop However, few farmers would consider that rust usually takes less than one hundredth part of the wheat crop, and yet, doubtless, this is a very low estimate of the actual annual loss occasioned to the wheat fields of Indiana The state being among the largest wheat producers of the country, it will be seen that our farmers, even at this low figure, must stand in the aggregate an annual loss of from 300 000 to 500 000 dollars The average annual wheat yield of the United States is placed at 512,763,500 bushels, Considering the value of this crop at 80 cents per bushel, a loss of one-hundredth part by rusts represents a total annual loss to the wheat producers of our *country of 4,102,108 dollars, figures which in themselves are quite* astonishing, yet must be low."

I have already stated that in Japan the crops on an average suffer a loss of 20 per cent from this cause

Narbadda *Conf with p 57*

In Sleeman's article, already referred to, he writes :—"When a crop is attacked it is often not worth the reaping," and again, "I have seen rich sheets of uninterrupted wheat cultivation for twenty miles by ten, in the valley of the Narbadda, so entirely destroyed by this disease, that the people would not go to the cost of gathering one field in four " "I believe the total amount of the wheat gathered in the harvest of 1827, in the district of Jubbulpore, was not equal to the total quantity of seed that had been sown " "The disease began first to

Season of Uredo Appearance *Conf with pp 53, 57-58, 89, 97*

manifest itself upon the leaves of the wheat about the 10th of March, 1829, and from that time I watched its progress till its work of destruction had been completed, about the end of the month " But I must again draw attention to the fact that this was a very unusually severe visitation

So much then for the general loss sustained by attacked areas. we see that it ranges from an annual minimum loss of one hundredth part of the possible produce through 20 per cent (in Japan) and 50 per cent (a general estimate in some regions), to complete loss in years of exceptional visitation It will be interesting, with these data to consider the possible and probable financial loss occasioned by the parasite in India Basing our calculation on the very low estimate given by Bolley for Indiana, namely, one hundredth part of the crop, we arrive at the following results.—The estimated outturn of wheat during the year

* *Loc cit*

[illegible] for the whole of India, was 6,510,797 tons raised from [illegible] acres, and the value of this crop, at the rates adopted in the Inland Trade Returns, is R410,191,677 If rust and mildew are prevalent throughout the wheat producing areas of India, then *the least loss occasioned by it* may be set down with comparative certainty at [illegible] annually But as I have no direct evidence that rust is universally present throughout India, I would prefer to estimate the loss which is probably sustained in those parts of India in which I know that the disease certainly exists, namely, in the Panjab, North-West Provinces and Oudh, Central Provinces and Berar In these parts, the average area under wheat cultivation during the four previous years was 16,731,000 acres, and the outturn of wheat in 1888-89 was 4,354,567 tons. This was valued at R296,152,594, and a loss of one-hundredth means a loss of nearly three millions of rupees annually to the wheat producers of the area I think there is no doubt whatever that this loss is considerably under estimated, and that *it is much more likely to be five times as great.* My reason for making this last statement is based upon certain direct observations made upon the pernicious effect of the parasite on individual plants The contrast between grains of wheat taken from perfectly healthy plants and those taken from mildewed plants is very striking, and I have attempted to show this in Plate II, figures 10-13, from a photograph; but as this does not convey any accurate idea of solidity, I have so arranged it that the groups of grains represented are of equal weight The healthy grains, and those taken from plants that had been *attacked* by Puccinia graminis *(Rolls)*, were received from Jeypore, already cleaned from the ear I placed ten of the former into one pan of a pair of scales, and found that they required from 26 to 36 grains of the latter to balance them or, on the average of several weighments, 30 grains We have here then a loss of 200 per cent in the case of individually attacked plants The samples of P Rubigo I received from Jeypore had not their grains taken out I did this myself, however, and from two ears (which to outward appearance were as full looking as healthy ears) I obtained only thirty-seven miserably shrivelled up grains, which were equal in weight to only four sound grains Here then was an enormous loss of 825 per cent * Lastly, I extracted the grains from the ears of mildewed specimens which I received from Dumraon (attacked with P Rubigo) and found that they were not nearly so reduced as the corresponding Jeypore grains, twenty of them equalling in weight the ten sound Jeypore grains In this case, therefore, there was a loss of 100 per cent These data are not, of course, absolute indications of the harm done by the parasite to each plant attacked, they are quoted only to show that the disease has most destructive results The amount of loss occasioned in the years of individual plants must depend upon the period of its life at which it was attacked, the extent to which it is attacked, etc, these again depending on weather, soil, and other conditions

It has also occurred to me that some presumptive evidence might be obtained of the prevalence and influence of rust and mildew in India, by

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WHEAT
India's Losses.
Conf with p 71

Equal Weights of Healthy and Diseased Grain.

* I found later that 10 healthy grains weighed 60 of these, i.e., 500 per cent.

FUNGI	Commoner Rusts and Mildews

VI. RUST.

Prices in relation to *Rust.*

comparing the outturn of wheat for a series of years, in those provinces in which the fungus certainly exists, with the climatic conditions prevailing during the earliest months of the year, when the wheat plants are in the stage of existence most liable to attack Dr George Watt, C I E, has kindly given me a tabular statement showing the price of wheat (seers per rupee) for the 29 years, 1861-89, in the Central Provinces, Panjab, and North-West Provinces and Oudh, and as this appeared to me to be a good index of the outturn of grain for each year, I have thrown the results into a graphic form (Plate III) Unfortunately, meteorological data are available to me only from 1875 From a summary of meteorological conditions, prepared annually for the Sanitary Commissioner with the Government of India, I have extracted the data necessary for my purpose, and have exhibited them in the Table on next page The weather during January, February and March is most important in this connection not only because it has a maximum effect on the growth of the wheat plants themselves independently of any fungal attack, but also because this is the season during which the parasite usually attacks these plants The humidity of the air, the cloud proportion, and the rainfall, are the most important factors A combination of all these in slight excess (except perhaps cloud) is, I presume, favourable to the growth of the host (wheat plants), and is certainly (especially including cloud) favourable to the growth of the fungus. Now, if in any year we find that these climatic conditions were favourable to the growth of the wheat plants, but that the outturn of wheat was, nevertheless, poor, we may with some plausibility attribute the deficiency of outturn to the repressive influence of the parasite, for otherwise I do not know how the deficient outturn could be accounted for In order to render the meteorological data readily comprehensible, and comparable with the graphic representation of the outturn of wheat each year, I have arranged them in a compressed tabular form, indicating excess over the average by X, and deficiency by D, whilst a normal condition is represented by N Wherever a very decided condition, either of excess or deficiency, was noted in the meteorological report, I have enclosed the letter X or D within a circle. In a few instances the condition was not clear, and in such cases I have inserted a mark of interrogation

Important Uredo Season *Conf with* *i p 53, 87*

Chief Factors

Before proceeding to a comparison of the outturn with these meteorological data, it would be well to warn the reader that he must not expect too close a parallelism between *average* favourable weather conditions and indications of rust prevalence Cloud and rain at particular seasons (especially January to March), are together very favourable conditions for the attack of cereals by the fungus, but a very few days of each would suffice for attack, and these days might not bring the average cloud proportion and rainfall of the month up to a normal standard Still, on the whole, we would expect to find a decided, though not perhaps a close, parallelism, and this, I think the data disclose

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METEOROLOGICAL TABLE II—See page 89

CENTRAL PROVINCES

	Humidity January	Humidity February	Humidity March	Humidity April	Humidity May	Cloud January	Cloud February	Cloud March	Cloud April	Cloud May	Rain January	Rain February	Rain March	Rain April	Rain May
1875	D	\	D	D	D						D	D	D	D	D
1876	D	D	\?	D	D						D	D	D	D	\
1877	⊗	X	\	X	X	⊗	X	X	⊗	⊗	X	\	X	⊗	\
1878	X	X	D	X	\	\	\?	D	X	N?	?	\	D	X	X
1879	D	D	D	Ⓓ	X	\	X	D	Ⓓ	\	D	D	D	D	X
1880	D	D	D	D	D	Ⓓ	D	D	D	D	D	D	D	D	D
1881	D	N	\	X	D	D	X	X	X	N	D	D	X	D	D
1882	D	D	D	D	D	D	Ⓓ	D	N?	X	D	D	D	N	D
1883	\	D	N?	Ⓓ	D	\	\?	X	D	D	D	D	N	D	D
1884	\?	D?	Ⓓ	D	D	D	\?	D	X	D	\?	D	D	D	D
1885	○	\	N	D	X	\	D	X	X	X	X	X	N	\	X
1886	\	\	\	D	\	X	N	X	D	\	D	D	D	D	N
1887	\	D	D	D	D	\	D	D	\?	N	X	D	D	D	D
1888	\	\	D	D	D	D?	D?	D	N?	D	⊗	N?	D	D	D

PANJAB

	Humidity January	Humidity February	Humidity March	Humidity April	Humidity May	Cloud January	Cloud February	Cloud March	Cloud April	Cloud May	Rain January	Rain February	Rain March	Rain April	Rain May
1875											D	D	D	D	D
1876	D	D	X	D	D						\?	D	N	X	?
1877	X	X	X	X	X	⊗	X	X	⊗	X	X	⊗	D	X	X
1878	\?	X	Ⓓ	X	N	D	X	D	X	X	D	X	Ⓓ	X	X
1879	Ⓓ	D	D	Ⓓ	Ⓓ	\	D	X	D	D	D	D	X	D	Ⓓ
1880	D	\?	N	D	D	D	X	D	D	D	D	N	D	D	D
1881	D	D	X	X	X	Ⓓ	X	X	X	N	D	D	X	N	D
1882	X	X	D	D	D	X	D	D	N?	\	X	D	D	X?	D
1883	\	\?	D	X	D	X	D	N	D	N?	X	D	N?	D	\?
1884	\	X	X	D	D	X	N?	N?	X	D	D	D	D	D	D
1885	\	X	N	X	\	X	D	X	\	X	X	D	D	X	X
1886	X	N	X	D	N	\	N	X	D	X	X	D	X	D	D
1887	\	D	D	D	D	X	\	D	D	N?	D	D	D	D	D
1888	\	X	D	D	Ⓓ	\	X	N	D	D	D	X?	D	D	D

NORTH-WEST PROVINCES AND OUDH

	Humidity January	Humidity February	Humidity March	Humidity April	Humidity May	Cloud January	Cloud February	Cloud March	Cloud April	Cloud May	Rain January	Rain February	Rain March	Rain April	Rain May
1875		X	D	D	X?						N	X	D	D	\?
1876	D	D	D	D	D						D?	D	\	D	D
1877	X	X	X	X	X	⊗	X	⊗	⊗	X	X	\	X	\	D'
1878	X	X	D	X	X	X	\	D	\	X	X	D	Ⓓ	\	X
1879	D	D	D	Ⓓ	D	\	X?	\	D	D	D	Ⓓ	D	D	D
1880	D	X	X	D	X	D	X	D	D	D	D	N	D	D	D
1881	D	N	X	X	X	Ⓓ	X	X	X	N	D	D	\	D	D
1882	X	D	D	D	D	X	D	D	N?	X	\?	D	D	D	N
1883	X	D	D	N?	D	X	D	\	D	N	D	D	N	D	X
1884	X	N	Ⓓ	D	D	D	N?	D	X	D	D?	D	D	D	D
1885	X	X	\	D	X	⊗	D	X	X	X	X	N	D	D	N
1886	X	N	X	D	X	X	N?	X?	D?	X?	\	D	\	D	X
1887	X	D	D	X	D	X	D	D?	D?	N	X	D	D	D	D
1888	\	⊗	D	Ⓓ	D	N?	N?	D	D	D	X	D	D	D	Ⓓ

EXPLANATION.—Favourable conditions in Excess = \, Deficiency = D, Normal = N. Very decided condition of Excess or Deficiency = ⊗ or Ⓓ; and when doubtful = ?—*Ed.*

F. 725.

FUNGI	Commoner Rusts and Mildews

VI
RUST

Central Provinces

Unfavourable to Disease and Cheap Grain

1875 Humidity and rain on the whole deficient, no data for cloud Conditions unfavourable to both host and parasite, but especially to the latter Outturn rose

1876 Conditions much the same Outturn very slightly in excess of the previous year

Favourable to Disease

1877 Humidity cloud and rain, all in excess These conditions (not being extravagantly excessive) are favourable alike to general vegetation and to the growth of the parasite The fall in outturn and rise in prices may in this case be attributed with considerable probability to the parasite, otherwise we should have expected a high outturn

Prevalence of Disease Prices high

1878 Humidity on the whole excessive (except in March), cloud on the whole somewhat excessive, *rain excessive (except in March)* These conditions are favourable both to the host and to the parasite, but especially to the latter As the outturn fell greatly, it is difficult to avoid the conclusion that the parasite had much to say to it

Unfavourable to Crop Prices high

1879 Humidity on the whole deficient, especially in April, cloud normal in January, slightly in excess in February, and deficient in March and April (especially in the latter month), rain deficient in all months except May Conditions decidedly unfavourable to the fungus, but also to the host, from excessive dryness Outturn very small and prices high

1880 Humidity, cloud and rain deficient in all months These conditions decidedly unfavourable to the parasite, and also to the host A small rise in outturn

1881 Humidity deficient in January, normal in February, and excessive in March and April cloud on the whole excessive, rain deficient, except in March Conditions on the whole as favourable to host as to fungus Outturn rose, but only to the level of 1877, a year whose deficit we traced to the possible influence of rust

Unfavourable to Crop

1882 Humidity deficient, cloud on the *whole deficient (especially in* February), rain on the whole deficient (with the doubtful exception of April) Conditions unfavourable to host, and especially to parasite The fall in outturn was therefore probably due to the direct influence of climate on the host

Favourable to Disease

1883 Humidity excessive in January, deficient in February, about normal in March, and very deficient in April, cloud on the whole excessive in the earlier three months, and deficient in April and May, rain deficient, except in March. Conditions fairly favourable to the host, and a normal humidity, with excessive cloud and normal *rain in March would* be favourable to fungal development Outturn fell slightly

Unfavourable to Disease: Prices fell.

1884 Humidity about normal in January and February, very deficient in March, and generally deficient in April and May, cloud deficient in January and March, about normal in February, and excessive in April; rain about normal in January, but deficient in the remaining months

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The deficiency in rain unfavourable to the parasite, but the conditions were on the whole favourable to the host. Outturn rose somewhat.

Favourable to both Disease and Crop.

1885. Humidity excessive in January and February, normal in March, and deficient in April; cloud excessive in January, March and April, but deficient in February, rain generally excessive Conditions very favourable to both host and parasite. Outturn rose, but slightly.

1886. Humidity excessive in January and March, normal in February, and deficient in April; cloud the same, rain deficient in all months except May, when it was normal The conditions, but for the deficiency in rain, would have been very favourable for the fungus and host, but the rain deficiency was unfavourable to both Outturn fell considerably

1887. Humidity excessive in January, but deficient thereafter; cloud much the same, rain excessive in January, and deficient thereafter Conditions in January most favourable to the parasite, but the climate in the succeeding months was unfavourable to both host and parasite. Outturn continued to fall

Favourable to Disease Prices rose.

1888. Humidity excessive in January and February, but deficient in the remaining months; cloud was on the whole deficient, rain was excessive in January, but thereafter on the whole deficient Conditions in January very favourable to the fungus, and generally they were favourable to the host. Outturn fell slightly

PANJAB

Cheap Grain

1875 No data for humidity and cloud, rain deficient throughout Condition unfavourable to the fungus Outturn rose

1876 Humidity deficient, except in March, no data for cloud, rain on the whole about normal Conditions favourable to host, and possibly also to the parasite. Outturn rose slightly.

Depressing Influence of Disease

1877. Humidity excessive, cloud excessive, especially in January and April, rain excessive (especially in February), except in March Conditions apparently favourable to host, but especially to fungus. Outturn fell somewhat, and this may be attributed in great part to the parasite, as otherwise the outturn should have been greater than in the previous year

Rise in Price.

1878 Humidity in January, February and April excessive, but very deficient in March, cloud excessive in February and April, rain excessive in February and April, but deficient in January, and especially in March Conditions appear to be very favourable to the host and to the fungus especially in February Outturn fell considerably

Favourable to Disease.

1879 Humidity deficient in all months, especially in January and April; cloud normal in January, deficient in February, excessive in March, and deficient in April, rain deficient in all months, except March Conditions fairly favourable to the host, but excessive cloud and rain in March decidedly favourable to the parasite Outturn fell considerably

1880 Humidity on the whole about normal for the first three months, cloud deficient, except in February, when it was excessive; rain deficient throughout, except in February, when it was normal Conditions fairly

FUNGI.	Commoner Rusts and Mildews

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RUST.

1885 Humidity excessive in January and February, and normal in March, cloud very excessive in January, deficient in February, and excessive thereafter, rain excessive in January, normal in February, and deficient in March and April. Conditions favourable to the host but on the whole not favourable to the fungus Outturn rose

Conditions favourable to both
Prices rose.

1886. Humidity and cloud excessive in January and March, and normal in February, rain excessive in January and March, and deficient in February Conditions favourable to the host, and very favourable to the fungus Outturn fell, a good instance of the repressive influence of the parasite.

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Review of Data.

In reviewing these results, it appears to me that in the Central Provinces the weather conditions and the outturns of 1877, 1878, and 1883, but especially 1878, strongly support the view I hold, that the deficient outturns were very probably due to the parasite In the Panjab the case appears to me to be even stronger, as the years 1877, 1878, 1879, 1880 and 1881 were all years in which the weather conditions favoured the development of the fungus, and in which the outturns were lower than we should otherwise have expected them to be, while, on the other hand, the years 1882, 1883 and 1884 were adverse to fungal development, and the outturn steadily rose. Lastly, in the North-West Provinces and Oudh the conditions do not stand in strong relief, either for or against my argument The weather conditions of 1877 and 1878 were on the whole favourable to both host and parasite, and the outturns fell pointing to the fungus as the cause In the years 1876 and 1880 the conditions were fairly favourable to the host, but decidedly unfavourable to the fungus, and in each year a rise in outturn was recorded In 1881 and 1883, conditions were on the whole favourable to the host, and favourable to the fungus in March; but the favourable weather for the latter came late, and the outturn in the former year was slightly increased and in the latter year remained stationary.

Causation of Rust.

I will now proceed to make a few remarks regarding the causation of the disease Long before De Bary rediscovered, * in 1865, by actual experiment, the connection between the barberry Æcidium and the rust of corn, such a connection was firmly believed in by farmers both in Europe and America, and, indeed, the compulsory removal of all bar-

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VI. WHEAT.

berry bushes was enforced by legislation in several places, *e g*, by the Barberry Law of Massachusetts, published on Jan 13th, 1755. This fungus, whose life history is completed on the barberry and cereals, (wheat, barley, rye, oats), and certain wild grasses, goes by the name *Puccinia graminis, Pers* Its diagnostic characters on the cereals are that the uredospore (*i e*, the orange-red spores on the leaves in the early stage, and popularly known as "rust") is more oval than round, and has two germ-pores on the short equator opposite one another; and that the teleutospores (*i e*, the spores from the black pustules, which are formed later, and which constitute the disease popularly known as "mildew") are naked, *i e*, not covered by the epidermis of the host, are much thickned at the apex, which is also well rounded, and are provided with long stalks. This fungus is the most prevalent, and probably the most destructive, in Europe. There are, however, two other species of rust and mildew whose life-cycles in Europe were likewise discovered by De Bary on the same crops These are (2), Puccinia Rubigo vera, *D C* (synonyms, P. striæformis *Westendorp*, and P. straminis, *Fuckel*), and (3), Puccinia coronata, *Corda*. The former completes its life-history on several species of borages and the latter on some species of buckthorn (Rhamnus) The main diagnostic characters of P. Rubigo are that its uredospore is rounder than that of P graminis with several germ pores irregularly scattered over its surface, and that its teleutospores are not naked but covered by the host's epidermis, are mostly squared at the free end without appreciable thickening and are exceedingly short stalked The teleutospore beds are in Europe surrounded by hair like structures termed technically paraphyses, but these structures were not present in any of the specimens I have examined in India We need not consider the characters of the third species (P coronata), since it is of rare occurrence on cereals, and plays no important part, I have never seen it myself on any Indian cereal, though I have found it frequently on a wild grass (*Brachypodium sylvaticum*)

Characters of Uredospores. Conf with pp. 42, 47.

Characters of Teleutospores Conf with p. 47, Fig 11.

Conf with pp 107 113

The predominant part played by P graminis in Europe led most observers in other parts of the world to assume that the same species was also the most destructive with them, and this notwithstanding the absence in many places of the barberry, which De Bary showed to be necessary for the continued existence of the parasite Thus, throughout the plains of India there is no species of barberry, and I believe there is no barberry in Australia In the case of the plains of India, it was necessary to assume that the wheat plants were attacked by the æcidiospores of the barberry, which had been wafted to them from enormous distances, as, with the exception of several species of Berberis in the Khasia hills, one on Parisnath (B asiatica), two on the Nilgiris (B. aristata and B. nepalensis), all the rest are Hymâlayan. The spores are exceedingly minute, and it is quite possible that they may be carried by the winds to such immense distances I found, however, from a careful examination of the specimens I received through the kindness

Absence of Barberry Conf with p 99

Distribution of Spores. Conf with pp. 13 81, 95

FUNGI	Commoner Rusts and Mildews

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RUST

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VI
WHEAT

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Characters of Uredospores *Conf with pp 42, 47.*

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Conf with pp. 102 115

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Absence of Barberry *Conf with p 99*

Distribution of Spores *Conf with pp 19 51, 98*

FUNGI.	Commoner Rusts and Mildews

VI. RUST.

of friends from the various localities I have already mentioned, that the most prevalent species is not P graminis, but P. Rubigo-vera * Indeed, the only specimen of P graminis I received came from Jeypore, where P. Rubigo is also prevalent Should further observation confirm the opinion which I am now inclined to hold, namely, that the main cause of rust and mildew in India is P Rubigo, we need no longer trouble ourselves with a barberry connection But while we escape this difficulty we fall into another, namely, that, so far as our present knowledge extends, no Æcidium on any species of the Boragineæ is known This is in itself, however, no matter of marvel, as few botanists have interested themselves in this region of their science and such an Æcidium has never been looked for It is more extraordinary that P. Rubigo appears to be the most prevalent rust in the Simla region, where the barberry Æcidium (in one form at any rate) is most abundant, and where no borage Æcidium is known to me, although I have searched assiduously for such fungi generally for some years I would not, however, have it understood that such an Æcidium certainly does not exist in the Simla region, it is quite possible that it may have escaped my observation, though I do not think this probable, especially as, to be the cause of rust here, it must be common I am more inclined to think that the life history of P. Rubigo has a different course from that taken in Europe, and that the subject would well repay thorough investigation, not only in the interests of science, but also in those of economy. I may add that I have recently found, by experiment, that the barberry Æcidium is produced by a teleutospore on a wild grass with all the characters of P graminis, but I have never found this teleutospore on any cultivated cereal here Moreover, the season during which the barberry Æcidium is produced here is the summer, whilst the wheat and barley crops are raised here, as in the plains, during the winter months, and are reaped in April and May

Æcidium on Borage *Conf with* *pp. 46, 113, 128*

Æcidial Season *Conf with* *pp 38 53, 118*

I have figured the teleutospores obtained from specimens gathered at Dumraon, Jeypore, Gujrat Simla, and the Ghilghit valley (Plate II), and, if these are compared with the figures I have copied from Frank, it will be seen that they are typical P. Rubigo spores This will be the more striking if these figures are compared with Fig. 1, taken from a specimen of Jeypore wheat, representing a typical P. graminis teleutospore. Moreover, the teleutospore beds were in all cases (except those from which Fig. 1 were taken), covered with epidermis, and the uredospores, wherever I found them (Fig 4), presented the characters of P. Rubigo It is very astonishing to find that P. graminis occurs in Jeypore, and that the natives recognise the distinction, since they call P. graminis "Rolli," and P. Rubigo "Rolla" I am inclined, however, to think that it is a mere coincidence that the specimens I received

* Since I noticed this I received the Bulletin issued by Mr H L Bolley, already referred to, and I find that in Indiana, also, P Rubigo-vera appears to be the main cause of rust

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labelled "Rolli" and "Rolla" happen to have been different species, because it was stated by the zemindar that "Rolla" (P. Rubigo was less destructive than "Rolli" (P graminis), whereas from a very careful inspection of the grains I myself took from the ears of each named specimen showed that, on the contrary, the destructive effect of P. Rubigo ("Rolla") was, as I have already shown very considerably greater than that of P. graminis ('Rolli') (*Plate II, figs 10 to 13*) If P graminis is related to no other Æcidium but that on the barberry, and there is no reason to doubt it, then we have here an excellent instance of the great distance the æcidiospores can be carried, since, if these spores came from the Himálayas, the nearest barberry habitat, they must have travelled about 300 miles

Wind carried Spores *Conf with pp 19, 97*

I should not omit to note here, that P. Rubigo may apparently survive from year to year without any intermediate æcidial host, as the mycelium which produces rust and mildew has the power of surviving in a perennial form in the roots of grasses Such a continuous succession of the rust mycelium is, however, much more probable in Europe where crops, both of cereals and wild grasses, overlap one another, than in India, where analogous conditions are apparently absent or much rarer I am not aware that a single species of our summer or "kharif" crops (millets for the most part), which alternate with wheat in cultivation, harbours any species of Uredine (the order to which rust belongs)* I have endeavoured to get definite information on this important subject, but without success, and my own continuous and specially directed observations in Simla have failed to bring to light the existence of any Uredine on the summer crops which alternate with our winter cereal crops I have, for example, visited fields in the summer months with the special purpose of finding some species of Uredine, since I knew (also by personal inspection) that the wheat crops immediately preceding have been enormously rusted and mildewed and found no trace of any, and then I have again visited these same fields when they were again bearing wheat crops, succeeding the above-mentioned summer crops, and have found them again largely rusted I have also looked on wild grasses for surviving rust, but have found none

Mycelial Hibernation *Conf with pp 11 13 32, 63*

Uredine on Millets *Conf with p 33*

Uredo, Survival. *Conf with p 64*

An investigation into the causation of rust would be by no means a simple one It will be gathered from what I have already written that the subject is surrounded by many difficulties Still there is I think, every hope that a patiently conducted study of it would be rewarded with success, and, the cause being known, we would be in a position to apply remedies. Before light is shed upon its true cause probably much destructive work must precede constructive. In illustration of my meaning, I may draw attention to Sleeman's view that the rusting of wheat was due possibly to the transference of the disease from "Ulsee" (linseed) At the time

Conf with pp 17 20

* Since this was written, I have obtained Puccinia Pennisetl on Sorghum vulgare, but although Sorghum is usually a summer crop, yet the specimens I obtained from the Poona district were on a winter crop

FUNGI. | Commoner Rusts aod Mildews

VI. RUST.

he wrote, such an explanation was plausible enough, and even now (with the data he had) it is within the bounds of possibility Nothing is known, so far as I am aware, even at the present time, of the nature of that disease on "Ulsee", but, being struck with his explanation, I obtained a specimen of such diseased "Ulsee" from Dumraon (whence I also at the same time got the mildewed wheat specimens above referred to), and found it to be a species of Melampsora * (a genus certainly of Uredineæ), and this renders it almost certain that the disease on "Ulsee" is in no way related to the rust of wheat This is an instance of partial destructive work clearing the way towards a final solution of the rust question—partial, because it still remains to be proved that the teleutospores borne on the "Ulsee" *do not in fact attack the wheat* plant It is extremely improbable that they do Then, again, we must clear our ideas regarding the part played by the barberry. That it does not play any considerable part here in India appears highly probable, but that it does play some part is certain, from the occurrence of P. graminis in Jeypore.

Influence of Barberry. *Conf with p 96*

In conclusion, I must express my thanks to many friends for their assistance in procuring specimens for me of rusted crops, and for much valuable information on the prevailing local ideas regarding the causation of this blight. These are often quaint, but as they are not of scientific interest I have not noted them in this essay I am especially indebted to Surgeon Major T H Hendley, Rao Bahadur Thakuran Govind Singh Bahadur, of Chomu, and Thakuran Ragonath Singh, of Achrole, for the excellent specimens I received from Jeypore These were the most interesting as well as the most carefully collected specimens I received, including, as they did, specimens of true P. graminis, and showing that the zemindars are well acquainted with the difference between P. graminis and P. Rubigo vera Lieut Manners Smith was, also, kind enough to send me specimens from time to time, from Ghilghit, and these were of great and special interest My thanks are also due to Dr George Watt, C I E, for the interest he has taken in this matter and for statistical information (*Journal of Botany, Vol 30 of 1892*)

A Note on

Melampsora and Coleosporium.

"I have found considerable difficulty in separating certain Uredines into Melampsora and Coleosporium, mainly because *I have not been able* to observe the germination of the teleutospores sufficiently accurately Apart from this, however, the morphological characters of each group are sufficiently definitely set forth in Winter's work † to enable one to separate them with confidence, were these characters maintained in each species For example, it is stated that in the genus Melampsora the teleutospores

* *Melampsora Linl, Pers.*
† Die 'Pilze Deutschlands,' etc.

F. 725.

VI. MELAMPSORA.

are single-celled, or vertically divided, rarely horizontally, and that the uredospores are borne singly on basidia; whilst in the genus Coleosporium the teleutospores consist of several, usually four, super-imposed cells, and the uredospores are in short chains. But in the case of the Simla forms these characters are not separately maintained, for whilst in some species the *teleutospore forms conform with the description of* Melampsora spores the related uredospore forms resemble Coleosporium forms. This is the case, for example, with the parasites on Hypericum and Leptodermis. *In these species the teleutosporic forms are* distinctly of the Melampsora type, whilst the uredos being in well-defined chains *resemble* Coleosporium. As the teleutospores are the more important I have considered these forms species of Melampsora. In only one species, namely, that on a species of Salix, do the characters of the teleutospores and uredospores coincide with the descriptions given by Winter This would appear *to show that the distinctive characters of the uredospore* formation in the two genera, as usually given, are not of generic value Lastly, I would draw special attention to the formation of spermogonia in one of these fungi, namely, on Hypericum. So far as I am aware the existence of this form of fructification has never yet been observed in any other species either of Melampsora or of Coleosporium" (*Jour., Asiatic Soc., Bengal, Vol LVI, Pt II., No 3, 1887, p. 83*)

Spermogonia. *Conf. with p. 49*

Species No. 30, page 82.

Melampsora Lini, *Pers.*

Found on Linum usitatissimum, *L* ("*Ulsee*").

Conf. with pp. 17 20.

I obtained excellent specimens of species of Melampsora gathered on the 4th April 1890, at Dumraon, N.-W. Provinces. The leaves were very extensively attacked with orange-red pustules, oval to round, but coalescing freely and often involving most of the leaf-surface. These pustules are mostly epiphyllous, and they are often surrounded by a wall of epidermis *giving them the appearance of the æcidial fructification of* Phragmidium. In other parts dark crusts might be seen which were the teleutospore beds.

The uredospores are pale orange-red, and are accompanied by colourless capitate paraphyses, sometimes of very large size, the head exceeding the spores in diameter. They are round (Plate I, fig. 4, *a*) to oval, and the dried spores, when just immersed in water, measured 21-18 × 18-16 μ But after lying forty-eight hours in water most spores become spherical, measuring 24 to 21 μ in diameter The epispore is sparsely beset with spines. I could not ascertain the number of germ pores. The paraphyses had heads measuring 30-25 × 20 μ.

The teleutospores are long, cylindrical, or prismatic single-celled bodies, very *firmly adherent to one another laterally* (Plate I, fig. 4, *b*). They each exhibit a central nuclear space, and measured, altogether [illegible]-

VI. RUST

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VI. MELAMPSORA.

Spermogonia. *Conf. with p 40*

Species No. 30, page 82.

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Found on Linum usitatissimum, *L* (*" Ulsee"*)

Conf with pp. 27 20

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FUNGI. | **Commoner Rusts and Mildews**

VI PHRAGMIDIUM.

eight hours in water, 54-56 × 10-9 μ. They did not germinate after lying some days in water even up to June, and I conclude a period of rest is necessary before this can take place

Remarks—This is no doubt Melampsora Lini, *Pers* The spore measurements of the Indian species are compared with the statements of European authorities in the following table.—

	India	Schröter	Saccardo	Winter.
Uredospores .	21 18 × 18 16	22-15 × 16 14	24-15 × 18 14	24-16 × 17-14
Teleutospores	54 50 × 10 9	45 × 20	60 15 × 20-17	44 × 18
Paraphyses	30 28 × ^o	20 × 17		

Effect of Disease.

On this it need only be remarked that the Indian variety has much narrower spores than the European, and that it has also large-headed paraphyses These differences are not, however, important Taking some grains from extensively attacked plants I found that twenty-eight of them weighed against twenty sound grains The fungus has a very wide distribution Saccardo records it in Italy, Dalmatia, Britain, France, Austria, Switzerland, Germany, Hungary, Bohemia, Norway, Russia, Belgium, Asiatic Siberia, and North Africa (*Journal of Botany, Vol. 28 of 1890*)

Species No. 41, page 82.

Phragmidium subcorticium, *Schrank*

Found on Rosa moschata, *Mill*

"I found this host attacked by a species of Phragmidium early in September The leaves bore at this time both yellow uredo- and black teleuto spore pustules, the latter readily distinguishable from the species on Rubus by their smaller size, and by their irregular and general distribution over the lower leaf-surface, instead of being in special circular patches on the leaves On examining the yellow pustules they were found to contain numerous uredospores, with some immature-looking yellow teleutospores, while the black pustules contained mostly dark-brown teleutospores These spores were put at once into water, and while the uredospores germinated in the usual way no teleutospores did so

"The UREDOSPORES are angular orange-red bodies, with an epispore beset with numerous warts (almost spines) and punctured by 7 to 9 germ-pores They measure about 26 to 30 μ in diameter Only one germ-tube is emitted by each spore.

"The TELEUTOSPORES are readily distinguished from those on *Rubus* by their pointed or mucronate ends In young pustules some teleuto-

of Indian Cures.	*A. Fowler*	FUNGI.

spores are orange-yellow, though most are dark-brown. They are also more divided, each containing usually seven or eight cells, but sometimes even ten. They measure about 80 × 28 μ. An unusually long spore with ten compartments measured 125 × 28 μ. The spores are covered with coarse warts. Another peculiarity consists in a very well-marked bulging in the stalk with a cavity containing yellowish granular matter. These spores germinate only after a period of winter's rest. In April I obtained sporidial formation in spores I had kept since the preceding autumn. The sporidia are spherical, bright orange-red, and 9 to 10 μ in diameter. VI. PUCCINIA CORONATA.

"The æcidial stage consists in the formation of very bright orange-red beds, sometimes of very extensive area. These beds are formed on the leaves and on the smaller stems, and the mycelium bearing them always gives rise to hypertrophy, sometimes very extensive, on the stems. In the latter situation the hypertrophy is due to an excessive enlargement of the parenchyma cells between the hypodermis and the central vascular bundles. This stage is met with throughout the summer months. The æcidiospores are given off in long chains, but there is no peridium of any kind. The margin of beds is, however, fringed with club-shaped paraphyses. In this stage spermogonia are numerous. They are spherical, and frequently coalescing groups of them may be found on the upper epidermis immediately over the sori below. The æcidiospores are pale orange-red or yellow, oval bodies, measuring on an average 22 × 17 μ. The episporе is thick and beset generally with tubercles.

"A bush in my garden is frequently attacked with this æcidium-bearing fungus, but curiously enough it never bears uredo- or teleuto-spores.

"*Remarks.*—This is probably *Phragmidium subcorticium*, but the hyaline point at the free end of the teleutospores is not nearly so long as is given by Schröter and Plowright in their works. I would also draw attention to the resting property of the teleutospores, which is in strong contrast with the immediate germinability in the next species." *Jour. Asiatic Soc., Bengal, Vol. LIX, Pt. II, No. [illegible], 1890, p. [illegible].*

Species No. XX (a), page 82.

Puccinia coronata, Corda. Conf. with p. 61

Found on Rhamnus dahurica, Pall.

"The æcidium which occurs on this plant is not very common, although occasionally an attacked tree or bush is very extensively affected. The fully ripe æcidium may be found as early as the latter part of May, but it is more usually met with about the middle of July. The fungus attacks leaves, young stems, and drupes, the last sometimes

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eight hours in water, 54-56 × 10-9 μ They did not germinate after lying some days in water even up to June, and I conclude a period of rest is necessary before this can take place

Remarks—This is no doubt Melampsora Lioi, *Pers* The spore measurements of the Indian species are compared with the statements of European authorities in the following table.—

	India	Schröter	Saccardo	Winter.
Uredospores	21 18×18 16	22-15×16 14	24 15×18 14	24 16×17 14
Teleutospores	54 50×10 9	45×20	60 15×20-17	44×18
Paraphyses	30 28×20	20×17		

Effect of Disease

On this it need only be remarked that the Indian variety has much narrower spores than the European, and that it has also large-headed paraphyses These differences are not, however, important Taking some grains from extensively attacked plants I found that twenty eight of them weighed against twenty sound grains The fungus has a very wide distribution Saccardo records it in Italy, Dalmatia, Britain, France, Austria, Switzerland, Germany, Hungary, Bohemia Norway, Russia, Belgium, Asiatic Siberia, and North Africa (*Journal of Botany, Vol 28 of 1890*)

Species No. 41, page 82

Phragmidium subcorticium, *Schrank*

Found on Rosa moschata, *Mill*

"I found this host attacked by a species of Phragmidium early in September The leaves bore at this time both yellow uredo- and black teleuto spore pustules the latter readily distinguishable from the species on Rubus by their smaller size, and by their irregular and general distribution over the lower leaf surface, instead of being in special circular patches on the leaves On examining the yellow pustules they were found to contain numerous uredospores with some immature looking yellow teleutospores while the black pustules contained mostly dark-brown teleutospores These spores were put at once into water, and while the uredospores germinated in the usual way no teleutospores did so

"The UREDOSPORES are angular orange-red bodies with an epispore beset with numerous warts (almost spines) and punctured by 7 to 9 germ-pores They measure about 26 to 30 μ in diameter Only one germ-tube is emitted by each spore

"The TELEUTOSPORES are readily distinguished from those on Rubus by their pointed or mucronate ends In young pustules some teleuto-

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spores are orange-yellow, though most are dark brown. They are also more divided, each containing usually seven or eight cells, but sometimes even ten. They measure about 100 × 33 μ (an unusually long spore with ten compartments measured 126 × 33 μ). The spores are covered with coarse warts. Another peculiarity consists in a very well-marked bulging in the stalks with a cavity containing yellowish granular matter. These spores germinate only after a period of winter's rest. In April I obtained sporidial formation in spores I had kept since the preceding autumn. The sporidia are spherical, bright orange-red, and 9·5 to 12·5 μ in diameter.

"The ÆCIDIAL STAGE consists in the formation of very bright orange-red beds, sometimes of very extensive area. These beds are formed on the leaves and on the smaller stems, and the mycelium bearing them always gives rise to hypertrophy, sometimes very excessive, on the stems. In the latter situation the hypertrophy is due to an excessive enlargement of the parenchyma cells between the hypoderma and the central vascular bundles. This stage is met with throughout the summer months. The æcidiospores are given off in long chains, but there is no peridium of any kind. The margin of beds is, however, fringed with club-shaped paraphyses. In this stage spermogonia are numerous. They are superficial, and frequently coalescing groups of them may be found on the upper leaf-surface opposite a bed of spores below. The æcidiospores are pale orange-red or yellow oval bodies, measuring on an average 20 × 17 μ. The epispore is thick and beset externally with tubercles.

"A bush in my garden is frequently attacked with this æcidium bearing fungus, but curiously enough it never bears teleuto- or uredo- spores.

"*Remarks.*—This is probably Phragmidium subcorticium, but the hyaline point at the free end of the teleutospores is not nearly so long as is given by Schroter and Plowright in their works. I would also draw attention to the resting property of the teleutospores which is in strong contrast with the immediate germinability of the next species." (*Jour., Asiatic Soc., Bengal, Vol. LVI, Pt. II, No. 3, 1887, pp. 79-81.*)

Species No. 53 (a), page 82.

Puccinia coronata, *Corda?*

Conf. with p. 48

Found on Rhamnus dahuricus, *Pall.*

"The ÆCIDIUM which occurs on this plant is not very common, although occasionally an attacked tree or bush is very extensively affected. The fully ripe æcidium may be found as early as the latter part of May, but it is more usually met with about the middle of July. The fungus attacks leaves, young stem, and drupes, the last sometimes

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very extensively indeed When the leaf is attacked, the invaded areas are usually small, and generally only one patch occurs on each leaf These patches are dark reddish brown above, surrounded by a halo of pale yellow, and the orange yellow æcidia are borne on the lower or concave surface of the leaf, opposite the dark central part seen above The red colour of the patch is due especially to discoloration in the palisade cells, and the abnormal thickness to hypertrophy of the spongy tissue, the palisade cells retaining their normal dimensions and characters The tissues in the areas invaded are very extensively permeated by hyphæ, and many cells are destroyed While the thickness of the leaf-blade is normally 0 126 m m, it is about 0 440 m m in patches bearing ripe æcidia A patch of ordinary size measured 1 c m in total diameter, the central reddish brown part measuring 6 m m in diameter The patches are sometimes considerably larger, however, and more irregular in shape The æcidia are tubular structures, very deeply sunk into the laminal tissue measuring about 1 75 m m in length, and therefore resembling in some degree the ÆCIDIUM on Pyrus variolosa described below With very few exceptions the æcidia burst from the lower surface of the leaf These patches on the leaves are often placed near the margin of the leaf, and are usually between, and not over, the principal veins, but when a vein is involved it is considerably thickened When the stem is attacked, which occurs but rarely, it is considerably swollen The drupes when attacked are often densely covered with æcidial tubes set at right angles all over them

"The SPERMOGONIA are formed on both the upper and lower surfaces of the patches, and may often be found ripe when the æcidia on the same patches are also fully developed They are inserted between the cells of the single layer of palisade cells when situated on the upper surface They have a tuft of paraphyses protruding through their mouths, and measure about 0 107 m m in depth and breadth

"The æcidiospores are round orange-yellow bodies of very uniform size, measuring 23 μ in diameter when recently wetted with water The peridial cells are roughly hexagonal, adhere very firmly to one another, and measure about 26 × 16 μ The centre of each cell contains orange-yellow matter like the contents of the æcidiospores

"*Remarks*.—There can be little doubt that this æcidium is caused by a Puccinia, with all the characters of Puccinia coronata, which occurs on Brachypodium sylvaticum in Simla, but unfortunately I have not had sufficient opportunities of verifying this. So far as my insufficient experiments go I have always obtained negative results. I am also not quite sure whether this æcidium does not also occur on Sageretia oppositifolia" (*Jour Asiat c Soc., Bengal Vol LVI, Pt. II, 1887, p 355*).

F. 725.

Species No. 53 (b), page 82.

Puccinia coronata, *Corda.*

(A.) on Brachypodium sylvaticum, *Beauv.*

This fungus is not very common, and is usually found in localities where an æcidium on Rhamnus davuricus, *Pall*, occurs. I have already expressed my belief that it is related to this æcidium,* although I have not been able to prove it by experiment. The teleutospore beds form very minute black points on the upper surfaces of the blade, sometimes arranged linearly; but they never coalesce to form linear beds. The uredo pustules are much larger, orange-yellow, and also on the upper surface of the leaf.

The uredospores are pale saffron-yellow bodies, with a finely punctated epispore, measuring, when just moistened, 20 to 24 μ in diameter. They germinate in the usual way by throwing out a single germ-tube. There are three or four germ-pores, but only one germ-tube is emitted.

The teleutospores are brown with the characteristic crown of generally regularly arranged processes. They are borne on short stalks, and each cell usually displays a well-defined nuclear vesicle. The total length of the just moistened spores is 38 to 44 μ, the upper cell measuring from 18 to 22 μ, and the lower, 19 to 26 μ; the width at the septum is 10 to 11 μ. The spore narrows gradually towards the stalk, and is scarcely at all constricted at the septum. They do not germinate until after a winter's rest. In the spring they germinate freely; the promycelium from the upper cell emerging from a point immediately under the crown, and that from the lower cell, from near the septum. Four sporidia are usually formed at the ends of short-pointed sterigmata. The sporidia are oval bodies measuring on an average 11 × 6·8 μ, varying from 10 × 6 μ to 13 × 9 μ. They germinate readily. The promycelium at the base measures 6 to 7 μ but opposite the sterigmata only 4 to 5 μ.

(B.) on Chrysopogon cærulens, *Nees.*†

This is an uncommon parasite resembling the above in the teleutospores being coronated, but I am inclined to think it is a distinct species, because the spores themselves have a different form, and the crown of processes is usually very irregular, contrasting with the usually regular crown of the fungus above described. Other noteworthy differences are the following:—The teleutospore pustules are linear, and on the lower surface of the leaf. Uredo pustules are placed also on the under surface, and these are produced throughout the winter, as I have found them

* J. A. S. B., Vol. LVI, Pt. II., No. 3, 1887.

† See correction on opposite page.

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late in autumn, and very early in February, whilst I have never found the uredo pustules of the foregoing fungus after summer.

The uredospores are circular, oval or pyriform, and, when just moistened, vary from 17 μ in diameter to 26×21 μ. Their contents are pale orange-yellow, but their coloured matter is characteristically confined to the centre of the spore, leaving a colourless periphery about 2 μ in depth; the epispore is smooth.

The teleutospores are adherent, falling off with a small portion of stalk attached. The crown processes, as already noted, are remarkably irregular, and the individual processes are often very long. The freshly gathered spores, when just moistened, have the following dimensions:— whole length 43 to 55 μ, the mean being 49 to 50 μ; the upper cell on an average 25 μ long, and the lower 24 μ, the breadth at the septum 8 to 12 or 14 μ. These spores, I found, germinated very freely in water so early as the 15th February, when most other teleutospores were still incapable of doing so, and when the spores of the foregoing fungus only commenced to germinate, without proceeding to the formation of sporidia. The lower cell usually germinated first. Four sporidia are usually formed on each promycelium, these are oval and measure about 9×7 μ.

(C) on Agrostis Hookeriana, *Munro.*

A third form occurs on Agrostis Hookeriana with characters more nearly resembling form B than form A. The teleutospores are almost identical in form and measure 44 to 50 μ in total length, and 8 to 10 at the septum. In the absence of biological data, however, it is impossible to say definitely whether all these forms belong to one species, but until these are forthcoming they may conveniently be grouped together. I have not seen any uredo-form on Agrostis (*Jour., Asiatic Soc., Bengal, Vol. LVIII., Pt. II., 1889, pp. 248-249*).

Species No. 53 (c), page 82.

On the Life history of Puccinia coronata, var. himalensis

INTRODUCTION.

In the first part of my "Descriptive List of the Simla Uredineæ" * I described the æcidial stage of this fungus on Rhamnus davuricus, *Pall.*, and latter, in the second part, † the uredo and teleutosporic stages on Brachypodium sylvaticum, *Beauv.*, and on Piptatherum holciforme, *Roem. & Schult.* In the latter communication I incorrectly named the last mentioned host Chrysopogon cœruleus, *Nees*, and at the time of writing was not aware that Festuca gigantea *Vill.*, also harboured the

* Journal of the Asiatic Society of Bengal, Vol. LVI, Pt. [illegible]

† *Ibid.*, Vol. LVIII., Pt. II., No. 2 (1889)

F. 725.

same teleutospore. In the former paper I also noted the probable generic relationship between these, but at that time I had not had opportunities for establishing the connection, and, indeed, the few inoculation experiments I had made were without result. Since then, however, I have devoted more time and attention to its life-history, and have been able to confirm the suspected relationship. The discovery of this relationship was indeed to be expected with confidence, and the investigation would scarcely have been worth undertaking were it not that my first inoculations failed, and there existed two microscopically very distinct forms of teleutospore though microscopically alike. These two considerations stimulated me to work at the life history. My first failures at inoculation made me suspect that the Puccinia coronata I found here might not run a parallel course with that at home, and I thought that, even if one form did, the other would certainly be different.

Æcidial Stage.—The æcidium is not widely diffused, though it is fairly common in certain localities. Ripe æcidia may be found as early as the latter part of May, but they are much commoner in July, i.e., in very moist weather. Individual shrubs may sometimes be seen largely attacked, but, as a rule only a few insignificant leaf-patches are met with. The leaf-blades are the most frequent sites of attack, but the small stems are also more or less frequently assailed. In my original description of this stage of the fungus* I noted also that the drupes were infested, and sometimes extensively so. I formerly described the fungus as it is seen on the leaves of Rhamnus, thus — 'When the leaf is attacked the invaded areas are usually small, and generally only one patch occurs on each leaf.' (But I would here add that occasionally a single leaf may bear numerous patches.) 'These patches are dark reddish-brown above, surrounded by a halo of pale yellow, and the orange yellow æcidia are borne on the lower, or concave surface of the leaf, opposite the dark central part seen above. The red colour of the patch is due especially to discolouration in the palisade cells, and the abnormal thickness to hypertrophy of the spongy tissue, the palisade cells retaining their normal dimensions and characters. The tissues in the areas invaded are very extensively permeated by hyphæ, and many cells are destroyed. While the thickness of the leaf blade is normally about 0.144 m.m., it is about 0.55 m.m. in patches bearing ripe æcidia. A patch of ordinary size measured 1 c.m. in total diameter, the central reddish brown part measuring 6 m.m. in diameter. The patches are sometimes considerably larger, however, and more irregular in shape. The æcidia are tubular structures, very deeply sunk into the laminal tissue, measuring about 2 m.m. in length and, therefore, resembling in some degree the æcidium on Pyrus Pashia.† With very few exceptions the æcidia burst from the lower surface of the

* *Loc cit*

† This fungus I subsequently described more fully in 'Scientific Memoirs by Medical Officers of the Army in India,' Part V, 1890, under the name Gymnosporangium Cunninghamianum.

leaf These patches on the leaves are often placed near the margin, and are usually between, and *not over*, the principal veins, but when a vein is involved it is considerably thickened When the stem is attacked, which occurs but rarely, it is considerably swollen"

I should here add that only the earlier peridia are long and tubular, *i.e.* those produced before the very wet weather sets in, after this the peridia are always very short; I believe the difference is due purely to an effect of climate Shrubs that I have inoculated with material from the same source in my garden outside bore both forms of peridia in their proper seasons. Mr J H Lace, of the Forest Department, sent me some specimens from the interior of the Himálayas, gathered in July, with long peridia, whilst in Simla at that time they were all short-tubed But the former region is beyond the influence of the south-west monsoon, and is, therefore, dry in July, whilst in Simla it is excessively moist

Teleutosporic Stage —With regard next to the general characters of the uredo and teleutospore stage of the fungus on Brachypodium sylvaticum and Piptatherum holciforme and Festuca gigantea, there are two points of particular interest The teleutospores on Brachypodium are minute black isolated points on the upper *surface* of the *leaf blade*, and are always naked, *i.e.*, not covered by the epidermis of the host, whilst those on the latter two hosts are shortly linear, on the lower blade-surface, and characteristically covered by the epidermis But though the epidermis covers the spore-bed, there is often a longitudinal split through the covering skin, and thus the spore-bed below may be seen with a field-lens These marked differences induced me to suspect strongly that the latter [illegible] though I provisionally coupled them with [illegible] the name Puccinia coronata, *Corda* [illegible] uredo pustules are found frequently on Piptatherum and Festuca throughout winter in sheltered places and in early *spring* on the newly-unfolded blades, long before Rhamnus bears any leaves These could not, therefore, have been produced by æcidiospores, and I suspected either that a continuous reproduction of uredospores occurred through the year (an improbable hypothesis) or that the mycelium persisted in the root, though I could not detect my hyphæ by microscopic examination Early in the spring of this year (1890) I uprooted a plant with dried leaves bearing numerous teleutospore pustules and kept in my laboratory with its roots in water, changing the water frequently It unfolded new green leaves shortly afterwards, and on the 17th of May I found several uredo pustules on one of them, *proving* almost conclusively that the mycelium is perennial In the case of Brachypodium I do not think the same condition exists, as it is rare to find uredospores on it until the æcidia of Rhamnus are ripe I did, however, one year find in one locality, in nature, several leaves of what I thought was Brachypodium bearing *uredospores* as early as the 29th of March It is possible, however, that I was mistaken in my identification of the host a somewhat difficult matter in Grasses before flowering, but the sp[illegible]es

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were fairly characteristic The only other explanation I can offer is that they were produced by uredospores from Piptatherum Had the mycelium been perennial in Brachypodium, I must have observed uredo pustules on the leaves as frequently as I did on Piptatherum

I would here also draw attention to another remarkable peculiarity of this fungus, and that is the long time during which the uredospores of Piptatherum and Festuca retain vitality and capability of germination under favourable conditions I collected some leaves, which were just beginning to wither, on the 16th of January, and these contained numerous teleutospore pustules, but also a few uredo pustules These leaves were cut up into small pieces, and kept in a glass breaker covered over loosely with a large watch glass On the 2nd June, *i e*, $4\frac{1}{2}$ months later, I scraped off spores and floated them on water and kept them in a moist atmosphere After 24 hours the uredospores had germinated most freely, although the teleutospores had not I shall recur to this subject later, meanwhile I proceed to a systematic description of the fungus

Vitality of Uredospores *Conf with pp. 85, 114*

I —Æcidium

a Spermogonia —These are not very numerous, and precede the æcidia by a considerable interval, they are formed on already highly hypertrophied parts, in which the mycelial filaments contain orange red oil globules The normal thickness of the leaf-blade being 0 144 m m, the parts bearing spermogonia are about 0 550 The spermogonia are both epi and hypophyllous but oftener epiphyllous They are deeply set measure about 0 107 m m in depth and breadth, and have tufts of protruding paraphyses

b Peridium —The peridial tube in dry weather is very long and sylindrical, measuring about 2 m m in length by 0 5 m m in diameter, and opening at the summit by frayed and everted edges It consists of a single layer of cells angular (4- to 6-sided) measuring 26 × 16 μ, containing orange red oil globules in the centre, and spiny The peridia are hypophyllous and usually on a deeply concave surface

c. Æcidiospores —These are bright orange-red, round to oval, beset densely with fine tubercles, measuring about 23 μ in diameter when fresh and just wetted, but 31 19 × 24 18 μ after being 24 hours in a moist atmosphere They germinate readily in water, throwing out long, simple, unbranched tubes, into the distal ends of which wander the coloured spore-contents, leaving the spore-walls colourless or grey The emptied spores are then seen, especially with staining, to possess six germ pores

II —Uredo

A On Brachypodium sylvaticum —These pustules are somewhat larger than the teleutospore pustules as a rule. They are orange-red circular, minute, isolated, very numerous, and epiphyllous The spores are pale saffron yellow or orange-yellow bodies (the coloured contents aggregated in the centre of the spore) round to oval, measuring

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24 20 × 21-15 μ The epispore is very finely tuberculated and is pierced by 3 to 4 germ-pores They germinate in the usual way, throwing out a single simple tube

B On Piptatherum holciforme and Festuca gigantea —The pustules are *shortly* linear to round, orange yellow, mostly epiphyllous, and several may often be seen on one discoloured patch extending right across the blade The spores are round to oval, pale yellow or orange yellow, with the coloured contents aggregated in the centre, echinulate, and measuring when fresh, 28-22 × 22-20 μ These uredospores are, there fore, considerably larger than those from Brachypodium Each spore has 4 to 6 germ pores They germinate in the usual way, throwing out a single unbranched tube, in the distal end of which the coloured contents accumulate, leaving the spore walls colourless

III —Teleutospore

A On Brachypodium sylvaticum —The pustules are minute black points on the upper leaf surface and quite naked The spores are brown, with the characteristic crown of usually regular processes, borne on short stalks The spores narrow gradually towards the stalk, and are scarcely, if at all, constricted at the septum They have a smooth epispore, and measure, when fresh, 44 38 × 11 10 μ (at the septem) They germinate only after a winter's rest, and I have observed this from the end of March to August The promycelium from the upper cell emerges from a point immediately under the crown, and that from the lower cell from near the septum Four sporidia are usually formed by each at the ends of short pointed sterigmata The sporidia are oval and measure 13-10 × 9 6 μ

B On Piptatherum holciforme and Festuca gigantea —The pustules are black, more or less completely covered by epidermis linear, and hypophyllous The spores are brown, crowned with processes, which are, however, generally more irregular than those above described, and borne on short stalks The crown processes usually number five, but vary from one to six or seven They do not narrow so regularly towards the stalk, and spores may frequently be found rounded in both cells and constricted at the septum They are smooth externally and measure 55 43 × 14 8 μ (septum) They germinate after a shorter rest, as I have seen them growing in my laboratory as early as the 15th February, when most other teleutospores still refused to do so After germination the spore-walls remain chestnut brown in colour Four sporidia are formed by each promycelium, measuring 9 × 7 μ They are pale orange yellow and often form secondary sporidia The fungus on this host is not unlike that described by Lagerheim as P. gibberosa * Nor apparently is it unlike Plowright's Puccinia Festucæ in general characters, but as the only account of this fungus, which I have seen, is contained in preliminary

* Bericht der Deutschen botanischen Gesellschaft 18[illegible] Bd VI, Heft 3 p 113

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description in the 'Gardener's Chornicle,'† I cannot pursue the comparison further. Plowright's fungus must, however, be entirely different, since it is associated with *Æcidium Periclymeni, Schum*. and I have never seen an æcidium on any genus of the Caprifoliaceæ in this region.

The dimensions of the spores of the Indian variety are contrasted with those of the European in the following table:—

		Æcidiospores	Uredospores	Teleutospores.
European . . .		$26\text{-}17 \times 21\text{-}13\,\mu$	$28\ 19 \times 21\ 16\,\mu$, 3 4 pores	$60\text{-}35 \times 21\ 12\,\mu$
Indian	Brachypodium	$31\text{-}19 \times 24\ 18\,\mu$	$24\ 20 \times 21\ 15\,\mu$; 3 4 pores	$44\ 38 \times 11\ 10\,\mu$.
	Piptatherum .		$28\text{-}22 \times 22\ 20\,\mu$, 4-6 pores	$55\ 43 \times 14\ 8\,\mu$.

The æcidiospores of the Indian variety are larger than those of the European, the uredospores are much the same in size, but are not associated with paraphyses, and the teleutospores are decidedly smaller.

The European æcidium is known to occur on several species of Rhamnus, whilst in India, in the Simla region it is known only on one of the four species prevalent The uredo- and teleutospore stages in Europe are known to occur on several genera of Grasses, including Festuca, in India they are, so far, known only on three genera though possibly future research may prove their occurrence on more.

Inoculation Experiments.—The teleutosporic stage on Brachypodium is apparently much commoner and in nature is evidently much more clearly connected with æcidial production on Rhamnus than the teleutosporic stage on the other two hosts, for wherever I found the æcidium on Rhamnus I have usually found Brachypodium with teleuto spores, though I have frequently, and indeed usually, missed Piptatherum and Festuca. The latter are, however, more difficult plants to recognize with certainty when only in leaf than Brachypodium.

(*Exper I*)—I therefore commenced inoculation experiments with teleutospores from Brachypodium, and had my first positive result on the 4th July, 1889, on the leaves of a twig which I had cut off and placed in water, and on which I had placed sporidia on the 25th June. After laying on the sporidia I placed the twig in a glass gardener's box outside, within which the air is always very moist On the 4th July several leaves showed very numerous foci of attack with spermogonia On the 24th July these leaves exhibited young æcidia

I had no further opportunity of continuing these experiments that year as the teleutospores refused to germinate any longer, but I resumed them this year (1890)

† 'Gardener's Chronicle,' July 12th, 1890, p 42

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(*Exper II*)—I placed some teleutospores from some specimens of Brachypodium collected on the 16th January in water on the 10th April on the 11th I noticed that free germination had taken place, with the production of numerous sporidia I placed these on the leaves of a twig of Rhamnus under a glass shade in my laboratory On the 16th (5 days) I noticed several foci of attack, though as yet there was no discolouration of the leaves, but only characteristic upheaved spots On the 19th (8 days) I counted 40 leaves on the twig inoculated, 21 of which were very distinctly attacked, as many as 12 distinct foci being observable on one leaf On another twig, similarly treated, I counted 12 leaves, of which 6 were attacked On the 30th both twigs began to wither without making any further progress, and the experiment came to an end

(*Exper III*)—Again, on the 7th May I inoculated a twig with sporidia derived from teleutospores collected on the 26th January and put in water the preceding day (6th) On the 19th May (12 days) I counted 8 sparmogonial spots on one leaf, and several spots on others, but unfortunately the twig began to wither and the experiment was closed There were immense numbers of foci of attack on these leaves

(*Exper IV*)—On the 12th April, as a parallel experiment to that described in the preceding paragraph, I inoculated several leaves of a twig with sporidia of teleutospores from Piptatherum which had been 24 hours in water, and the twig was then put under a separate glass shade in my laboratory On the 17th (5 days) several leaves showed decided spots of attack, which on the following day were yellow, bearing spermogonia On the 19th (7 days) I counted 41 leaves on one twig, 7 of which were very distinctly attacked, the highest number of distinct foci on any single leaf being 5 Another twig had 10 leaves, 2 of which were attacked, and a third had 12 leaves, 3 of which were attacked These twigs also withered before producing æcidia.

(*Exper V*)—On the 23rd May I inoculated two separate twigs with the sporidia of Piptatherum or Festuca gathered on the 5th February, and put each under a separate glass shade I purposely abstained from using any spores from Brachypodium for some days previously in order to avoid accidental contamination One of these twigs (A) showed one spot of initial attack (distinct spot of upheaval) on the 30th, and on the following day two such spots on the 14th these two spots were distinctly spermogonial, but there were also two other very distinct yellow spermogonial spots on each of two leaves (*i e*, four spots in all) and one younger point of attack on a third leaf Soon after this the twig began to wither, and the experiment was closed on the 21st The other twig (B) showed three spermogonial spots on one leaf on the 6th of June; but the twig was attacked by aphides and became sickly in appearance and the experiment was closed on the 14th

(*Exper VI*)—On the 16th June I inoculated a twig with the dry spores from Piptatherum or Festuca collected on the 5th February and

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kept in under a glass shade One spermogonial patch was ultimately produced

(*Exper. VII*)—On the 2nd July I inoculated some leaves with the sporidia of spores from Piptatherum collected on the 16th January, and on the 12th noticed four spots of attack in the spermogonial stage, all on one leaf The teleutospores were now found to be very sluggish in germination, the season for natural attack having come nearly to a close.

(*Exper VIII*)—I made only one experiment with a view to producing uredospore pustules with æcidiospores On the 1st August I placed a pot containing Brachypodium under some twigs of Rhamnus with ripe æcidia in a gardener's box, and on the 17th found the leaves covered with uredo pustules

From this account of my experimental inoculations, it will be observed that attack by the sporidia of spores from Piptatherum and Festuca was in all cases less vigorous than with the spores from Brachypodium From the beginning, after my first successful experiment, I had no doubt about the generic relationship between the Rhamnus æcidium and the teleutospores on Brachypodium, but I felt less certain about the connection of the parasite on Piptatherum and Festuca.

At first I feared that there might have been accidental contamination of my Piptatherum and Festuca material with spores from Brachypodium, and this is the reason why the experiments with the former were more numerous My subsequent experiments convinced me that the fungus on Piptatherum and Festuca is really capable of producing the æcidium on Rhamnus The difference in the vigour of attack is, however, noteworthy, and suggests the possibility that it may give rise more easily to some other æcidium on some other host.

General Remarks

Dr P Dietel, of Leipzig to whom I sent specimens of the æcidium on Rhamnus and teleutospores on Brachypodium, and to whom I am indebted for kindly criticism, informed me that both differed in habit from the European species I could not myself detect any striking difference of habit in the æcidium (*i e*, the form with short peridia) on comparing it with a specimen of the European Rhamnus æcidium he sent me in return, but the specimen was small, and I am not familiar with the appearance of the European form The difference in habit of the teleutospore pustules on Brachypodium is, however, very striking, and I have already alluded to the naked, small circular, epiphyllous pustules, in contrast with the covered linear, hypophyllous pustules at home When I sent specimens of the teleutospore on Brachypodium to Dr Dietel I did not know, and did not suspect that the similar spores borne by Piptatherum and Festuca were biologically the same The habit of the fungus on these two hosts corresponds closely with that of Puccinia coronata in Europe, so far as I can make out from written descriptions. We have, therefore, here the interesting fact disclosed that such striking differences

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(*Exper. II.*)—I placed some teleutospores from some specimens of Brachypodium collected on the 16th January in water on the 10th April; on the 11th I noticed that free germination had taken place, with the production of numerous *sporidia*. I placed these on the leaves of a twig of Rhamnus under a glass shade in my laboratory. On the 16th (5 days) I noticed several foci of attack, though as yet there was no discolouration of the leaves, but only characteristic upheaved spots On the 19th (8 days) I counted 40 leaves on the twig inoculated, 21 of which were very distinctly attacked, as many as 12 distinct foci being observable on one leaf. On another twig, similarly treated, I counted 12 leaves, of which 6 were attacked. On the 30th both twigs began to wither without making any further progress, and the experiment came to an end.

(*Exper. III.*)—Again, on the 7th May I inoculated a twig with sporidia derived from teleutospores collected on the 26th January and put in water the preceding day (6th). On the 19th May (12 days) I counted 8 sparmogonial spots on one leaf, and several spots on others; but unfortunately the twig began to wither and the experiment was closed. There were immense numbers of foci of attack on these leaves.

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VI. PUCCINIA CORONATA.

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of habit need not be associated with specific differences The interest of this discovery lies especially in its application to the rusts and mildews of cereal crops Puccinia graminis differs markedly from P. Rubigo vera, and P coronata in the teleutospore pustules being naked whilst in the latter they are covered, and Mr. T. J Burrill writes of P coronata, *Corda* —"This species is certainly close related to P Rubigo vera Indeed it is scarcely possible to separate them, except by the terminal projections of the teleutosposes in P coronata, and these are present in varying degrees, sometimes nearly wanting"* The interest of this is very great both in the United States and in India, so far as I am yet acquainted with the facts. Mr H L Bolley writes that Puccinia Rubigo vera is undoubtedly the most prevalent from the rust on wheat in Indiana, but there an æcidium occurs on Cynoglossum officinale † In India there is no doubt that P. Rubigo vera is also the most common (and very abundant) cause of rust on wheat and barley, but here no æcidium is known on any Borage I asked my friend Dr D Prain, of the Royal Botanic Garden, Calcutta to look through the whole collection of Boragineæ in the Herbarium there, as I thought that in so large a collection some specimens might be found attacked by an æcidium This he most kindly did, and wrote as follows —"I have gone over the whole of the Order carefully at two different times, and I cannot find a suspicious looking specimen in any of the herbaceous species" Even in Simla, as I have elsewhere‡ pointed out, where a Barberry æcidium is common, I have never seen P graminis on any cereal crop, whilst P Robigo vera is very abundant and destructive, and despite the most careful search I have never yet succeeded in finding an æcidium on any species of the Boragineæ It would exceed the limits of this paper were I to enter more fully into this side issue of my subject, but I will add that, whilst I have never found P graminis on any cereal crop here, I have found a teleutospore resembling P graminis on a wild grass probably Brachypodium distachyum, *Roem & Schult* and have artificially reproduced the spermogonial stage of an æcidium on Berberis Lycium, *Royle* with it. But my investigations into this matter are still incomplete I have several times applied the sporidia of P corooata, especially from Piptatherum and Festuca, to the leaves of Berberis Lycium and B aristata, *D C*, but without result

Boragineæ,
Conf with
1 P 40 97,
1.8

Vitality of
Uredospores

Before concluding I would draw attention to the remarkably long-retained vitality of some uredospores in this region I have noted above the power of ready germination of the uredospores from Piptatherum four and a half months after keeping This is, however, by no means an isolated case I first drew attention to this peculiarity in my 'Descrip

* Bulletin of the Illinois State Laboratory of Natural History, Vol II Art 3 "Parasitic Fungi of Illinois," Part I, 1885

† Bulletin of the Agricultural Experiment Station of Indiana (Purdue University), "Wheat Rust" July 1889.

‡ Journal of the Royal Agricultural Society, London [I believe this foot note to have been a mistake The paper to which Dr Barclay alludes appeared in The Journal of Botany, pp 95-97 above I cannot discover any paper of *Dr Barclay's* in the Jour, Royal Agri Society, London —EDITOR]

tive List of the Simla Ured neæ," in describing Puccinia Galii *Pers*, when I wrote:—"A curious feature about these uredospores is the comparatively long time they retained their vitality In a cultivation of teleutospores from material collected in October, and set in water on the 26th March following, all these uredospores present, of which there were several germ nated in 24 hours, whilst the teleutospores remained in *statu quo*"* Since then I have observed the same thing in the following species:— VI PUCCINIA CORONATA Uredospores Vitality of Conf with pp 65, 108

1 Uredo Bupleuri, *Mihi*, collected 2nd October, germinated 14th June, *i.e.*, 8 months and 12 days after.

2 Uredo Gomphrenatis, *Mihi*, collected 7th November, germinated freely 14th June, *i.e.*, 7 months and 7 days after.

3 Puccinia Prenanthes, *Pers*, collected 31st October, germinated (a few) 14th June, *i.e.* 7 months and 6 days after

4. Puccinia Caricis filicinæ, *Mihi*, collected 24th November, germinated 6th May, *i.e.*, 5 months and 12 days after

5. Uromyces Vossiæ, *Mihi*, collected on dried over-wintered leaves in nature, germinated freely in April, probably about 5 months after ripening

6. Puccinia Acetosæ *Schum* collected 6th December, germinated freely 23rd March, *i.e.*, 3 months and 17 days after

7 Uromyces Pisi, *Pers* (from Lathyrus sativus) collected 4th April germinated 19th June, *i.e.*, 2 months and 15 days after Conf with p. 130

8. Melampsora Lini, *Pers*, collected 4th April germinated 19th June, *i.e.*, 2 months and 15 days after Conf with p 8

9 Puccinia flosculosorum, *Alb et Schw*, collected 26th December, germinated freely on 12th March, *i.e.* 2 months and 17 days after

I shall conclude by again drawing attention to the similarity this fungus in the æcidial stage exhibits to the æcidial of Gymnosporangium *i.e.* in the long interval which elapses between the eruption of spermogonia and the formation of æcidia, and in the very deep seated position of the basidial layer These points are not in themselves of any real importance but they serve to strengthen the view I had been led to form gradually from other considerations that the distinction between Gymnosporangium and Puccinia is not of generic value. The chief characters of Gymnosporangium upon which its generic distinction is based are —

(*a*) the gelatinous nature of the stalks of the teleutospore,
(*b*) the displacement of the germ pore of the upper cell of the teleutospore from the apex to near the septum,
(*c*) the plurality of germ pores to each cell of the teleutospore,
(*d*) the absence of uredospores, and
(*e*) the peculiar characters of the æcidial fructification *i.e.* the length of the peridial tubes the depth to which they penetrate within the lamina of the leaf, and the long interval between the production of the spermogonia and the æcidia

* Journal of the Asiatic Society of Bengal, Vol LVIII Pt. II, No 2 (1889).

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With reference to (*a*), I have myself shown elsewhere* that a gelatinous sheath to the stalks of the teleutospores is not peculiar to Gymnosporangium, occurring as it does and (though to a minor extent) in Puccinia Prainiana, *Mihi* (Cæoma Smilacis, *Barclay*), and as De Bary has also depicted in the case of P Berberidis, *Montague* †

With regard to (*b*), although I know of no Puccinia which shows a displacement of the germ pore of the upper cell downwards, yet I have met with two species in which this occurs in the lower cell, namely, in Puccinia Geranii-slyvatici, *P Karst* var himalayensis, and P Wattiana *Mihi*.,‡ on Clematis Gauriana, *Roxb*

With regard to (*c*) Gymnosporangium still remains alone, so far as I am aware, in having more than one germ-pore to each cell of the teleutospore

With regard to (*d*) the absence of uredospores, this peculiarity is, of course, not rare and I have noted a remarkably striking instance in Uromyces Cunninghamianus (*Linn Trans ante*, p 141)

With regard to (*e*) the subject of this paper shows that it is also not peculiar to Gymnosporangium.

Thus, of all the peculiarities I have noted, the plurality of germ pores is alone entirely peculiar to Gymnosporangium =(*Trans Linn Soc*, *Vol III* (*2nd Series*), *Pt 6, 1891, pp 227-236*)

Species No. 59 (a), page 83.

Puccinia Fagopyri, *Barclay*.

On Fagopyrum esculentum, *Moench*

Conf with p 36

At the beginning of October I found some stray plants of this host growing on a weedy bank far from cultivated fields, largely attacked with a fungus bearing black and dark brown teleutospore and uredo pustules, all hypophyllous, with circular paled areas on the upper leaf surface

The UREDOSPORES are pale brown echinulate bodies oval and measuring $23 \times 18\ \mu$ on an average The spores germinated in water in the usual way I have occasionally seen a globular expansion at the end of the germ tube, as shown in the figure, but this is never separated off by a septum

The teleutospores are very deciduous, falling off with only a fragment of stalk adhering They are dark brown and very variable in size and shape, somewhat constricted at the septum, with a smooth surface, and slightly thickened at the apex A clear nucleolar space is seen in each cell The fresh spores measured from 25 to 36 μ in total length, by 11 to 13 μ at the septum The septum divides the spore into two almost

* 'Scientific Memoirs by Medical Officers of the Army in India,' Part IV, 1889, and Part VI, about to be issued

† Botanische Zeitung No 48 of 1873 p 846

‡ Journal of the Asiatic Society of Bengal, Vol LIX (1890) Pt II No 2

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equal halves The upper cell is often much broader than the lower, and is more or less globular The apical thickening is about 4 μ in depth, the cell wall elsewhere being about 2 μ in thickness The spores do not germinate immediately after ripening —(*Jour. Asiatic Soc, Bengal, Vol LIX, Pt II, No 2, 1890, pp 107-108*)

Species No. 59 (b), page 83.

Puccinia Fagopyri, *Barclay.*

On Fagopyrum esculentum, *Moench* (*'Phapra'' " Ogra,' "Kathu"*)

I have described this fungus elsewhere,* but my knowledge is imperfect I found plants very largely attacked in October, the leaves bearing immense numbers of black and brown pustules all hypophyllous. The brown pustules contained uredospores, which are pale brown, echinulate, oval, 23×18 μ on an average When placed in water they germinate in the usual way The black pustules contained teleutospores, which are deciduous, with a small fragment of stalk adhering to the detached spore They are dark brown, very variable in size and shape, slightly constricted at the septum smooth on the surface, slightly thickened at the apex, and measuring 36 25×13 11 μ The upper cell is often much broader than the lower and is more or less globular The apical thickening measures 4 μ, whilst the rest of the cell-wall is 2 μ —(*Journal of Botany, Vol 28, p 5*)

Species No. 61, page 83

Puccinia Fragariæ, *Barclay.*

Found on the Wild Strawberry—Fragaria Vesca, *Linn*

"During May, and just before it flowers, the Wild Strawberry Fragaria Vesca, may in some years be seen attacked by an æcidial fungus This parasite is, however, a rare one, and I found it on two occasions only in 1885 at localities distant a few miles from one another and on each occasion only a single affected plant was found Æcidial fructification was found both on the petiole and on the leaf-blade. It is somewhat curious that the same leaf bore simultaneously uredo- and teleutospore pustules but all the three forms of spore-pustules were quite distinct from one another, with green normal tissue between them—at least, I could not trace any mycelial connection between them The æcidial fructification consists of groups of æcidia on the margins of the leaves The portions of the leaf blade-bearing these quickly wither and dry up after the æcidia ripen The æcidia break through both the upper and

Conf with 1 30

* The passage quoted above, page 115, from *Jour, As Soc., Bengal* —EDITOR

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Conf. with pp. 34, 35.

Species No. 81, page 83.

Puccinia Sorghi, *Schw.*

On Zea Mays, *Linn.*

"I had long searched in fields of maize for a Uredine, but without success until 1890, when I found it in some fields at Mashobra. Up to this time I was acquainted with the fungus only on Sorghum vulgare, on specimens of the plant sent to me for examination from the Poona district. But this is absolutely the first record of its existence on maize in India, so far as I am aware. My specimens were gathered early in October. Pustules were found abundantly on both leaf surfaces, some covered entirely with a scale of epidermis, whilst others were more or less naked. The covered pustules contained uredospores, the naked ones mostly teleutospores, and the perfectly matured open ones, which are inky black, only teleutospores. Some pustules were minute and circular, others long and even linear.

"The uredospores are pale brownish red, round to oval, beset with shallow warts or short spines, and measure, when just wetted, 30-26 × 26-20 μ. By applying sulphuric acid I detected 3 germ pores in each spore arranged around the short equator.

"The teleutospores are firmly attached, breaking off with a portion of stalk adhering. They are reddish brown, rounded at both ends, thickened at the free end, constricted at the septum, and apparently smooth on the surface. When just wetted they measured 42-32 × 18-16 μ. They refused to germinate immediately after ripening. There were no paraphyses.

"This fungus is much more like Puccinia Sorghi than that which grows on Sorghum vulgare, and which I have described elsewhere.* In the first place the fungus on Zea has no paraphyses, and in the second the measurements of both uredo- and teleutospores approximate those given for Puccinia Sorghi much more closely. In the publication above alluded to I referred the parasite on Sorghum with hesitation to P. Sorghi. I am now inclined to think that the latter is a different species. Lastly, even later I found a Puccinia on Pennisetum typhoideum, *Rich.* (*Bajra*), at Erode in the Madras Presidency, which is undoubtedly the same as that on Sorghum. As neither of these fungi (on Sorghum and Pennisetum) are Himálayan I shall not describe them in detail here, but in order to enforce my argument that the fungus on Zea is P. Sorghi, whilst that on Sorghum and Pennisetum is a different species (which I shall call Puccinia Penniseti), I subjoin in tabular form their salient characters—

Conf. with p. 145.

Host	Uredospores.	Teleutospores.	Paraphyses.	Apical thickening.	Germ pore in uredospores.
Pennisetum . .	34-30 × 24-22	45-44 × 29-26	Present	None	2
Sorghum . .	34-30 × 22-20	50-41 × 27-22	Present	None	4-5
Zea . . .	30-26 × 26-20	42-32 × 18-16	None	Present	3

—(*Jour. Asiatic Soc., Bengal, Vol. LX, Pt. II, No. III, 1891, pp. 214-215.*)

* Journal of Botany, September 1890.

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UREDO
CRONARTII-
FORMIS

Species No. 90, page 84

Uredo Cronartuformis, *Barclay*

Found on *Vitis himalayana*, *Brand*

"This host is very extensively attacked with a peculiar uredo-like affection, suggestive of Cronartium, since the spores are aggregated together into small cylindrical columns, with numerous curved paraphyses are borne on minute papillæ on the lower leaf-surface. The column of spores is about 1 to 2 mm in length, and 0·19 to 0 25 mm in diameter

"The parasite is first met with towards the end of July, but continues to increase in abundance until the leaves fall off in autumn (October and November) The pustules are exceedingly small, and are distributed in immense numbers all over the lower surface of the leaf-blade The upper surface of the leaf is studded with reddish brown stains, which makes this otherwise inconspicuous fungus remarkable.

"When these columnar heaps of spores are scraped off, which may very easily be done with a light touch, and placed in water, they readily break up into their component elements, and the weight of a cover glass immediately dissociates the spores Even when a leaf bearing these columns is first hardened in absolute alcohol the columns do not attain any greater coherency

"The individual spores are obovate or club shaped, and fairly densely covered with spines They are pale orange-yellow, and measure about 30×18 to 27×18 μ when fresh.

"The earliest formed pustules are yellowish in colour, but later, at the end of August, when the fungus is extremely common, the pustules are brown. The leaves are now old and this may be the sole reason for the spore columns and spores are identical in size and structure though the latter are also brownish now Placed in water the spores of both colours germinate similarly, exactly like uredospores, and very readily, even up to the middle of October.

"In August, when the parasite is beginning to appear, I tied some leaves bearing yellow pustules to a plant in my garden which was quite healthy, and in September many of its leaves were studded with similar yellow pustules

"Although I looked carefully and continuously for some teleutosporic form I never found any trace of such"—(*Jour, Asiatic Soc, Bengal, Vol LIX, Pt II, No 2, 1890, pp 98 99*)

Species No. 92, page 84

Uredo Ehretiæ, *Barclay*.

On Ehretia serrata *Roxb*

Conf with p 46

"This fungus was collected by Mr J S Gamble on the banks of the Tons river near Chakrata The leaves are attacked by a Uredinous

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Conf. with pp. 34 35

Species No. 81, page 83.

Puccinia Sorghi, *Schw.*

On Zea Mays, *Linn.*

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* Journal of Botany, September 1890.

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Uredo Cronartiiformis, *Barclay*

Found on Vitis himalayana, *Brand*

"This host is very extensively attacked with a peculiar uredo-like affection, suggestive of Cronartium, since the spores are aggregated together into small cylindrical columns, with numerous curved paraphyses are borne on minute papillæ on the lower leaf surface The column of spores is about 1 to 2 mm in length, and 0 19 to 0 25 mm in diameter

"The parasite is first met with towards the end of July, but continues to increase in abundance until the leaves fall off in autumn (October and November) The pustules are exceedingly small, and are distributed in immense numbers all over the lower surface of the leaf-blade The upper surface of the leaf is studded with reddish brown stains, which makes this otherwise inconspicuous fungus remarkable.

"When these columnar heaps of spores are scraped off, which may very easily be done with a light touch, and placed in water, they readily break up into their component elements, and the weight of a cover glass immediately dissociates the spores Even when a leaf bearing these columns is first hardened in absolute alcohol the columns do not attain any greater coherency

"The individual spores are obovate or club shaped and fairly densely covered with spines They are pale orange-yellow, and measure about 30×18 to $27 \times 18\ \mu$ when fresh.

"The earliest formed pustules are yellowish in colour, but later, at the end of August when the fungus is extremely common, the pustules are brown. The leaves are now old and this may be the sole reason for the spore columns and spores are identical in size and structure though the latter are also brownish now Placed in water the spores of both colours germinate similarly, exactly like uredospores, and very readily, even up to the middle of October.

"In August, when the parasite is beginning to appear, I tied some leaves bearing yellow pustules to a plant in my garden which was quite healthy, and in September many of its leaves were studded with similar yellow pustules

"Although I looked carefully and continoously for some teleutosporic form I never found any trace of such"—(*Jour, Asiatic So, Bengal, Vol LIX, Pt II, No. 2, 1890, pp 98 99*)

Species No. 92, page 84

Uredo Ehretiæ, *Barclay.*

On Ehretia serrata *Roxb*

Conf with p. 40.

"This fungus was collected by Mr J S Gamble on the banks of the Tons river near Chakrata The leaves are attacked by a Uredinous

FUNGI	Commoner Rusts and Mildews

VI
UREDO EHRETIÆ

fungus of somewhat uncertain nature. Some leaves had circular spots varying in diameter from 1 to 8 mm, whilst others had large hypertrophies of the petiole as it enters the lamina, and these were uniformly covered with bright orange red pulverulent spores Transverse sections through the fungus and leaf show that the spores are not borne separately on stalks but form a cup like depression like the pit of an æcidium without any peridium There were also numerous superficial spermogonia The spores are orange red oval or pear shaped, very spiny, decidedly thickened at the free end (reminding one of the æcidio- and uredospores of Puccinia Prainiana) When just wetted they measure 38-30 × 22 20 μ They become detached without any portion of the stalk adhering The spores are given off from both surfaces of the leaves By applying nitric acid I saw that each spore had two germ pores

" This is the first member of the Boragineæ which I have seen attacked in India by a Uredine As Puccinia Rubigo vera, or some variety or allied species, is undoubtedly the most prevalent and destructive rust on wheat, barley, and oats in India, I had long looked for some associated form on a Boragineous host, and this not only by personal search, but also by correspondence I am afraid, however, that this particular Uredine cannot be the associated form I have been looking for, although it is just possible that it is For although the spores are given off like uredospores, the cup shaded depressions in which they are formed, the presence of spermogonia, and the hypertrophy of the host's tissue all render it possible that we have here an anomalous æcidium This question will have to be tested by experiment'—(*Jour, Asiatic Soc., Bengal, Vol LX, Pt II, No III, 1891, pp 228-229*).

Species No. 98, page 84.

Uromyces Agropyri, *Barclay*

On Agropyrum, sp.

Conf with pp. 49-51

This grass was collected by Mr. Lace, *Forest Settlement Officer* at Ralli (Bashahr), 7,000 feet in October

On some leaves there were light brown pustules on both leaf surfaces and these contained uredospores Other pustules were long, linear and black on the under leaf-surface, somewhat resembling pustules of P. graminis

The uredospores are round to oval, pale brown, densely warted, with several germ pores (4 to 5), and measured, when just wetted, 23-20 × 21-19 μ

The teleutospores are lightly adherent to their beds, coming off with a small piece of stalk attached They are light yellowish brown, much thickened at the apex, smooth on the surface, with a clear nuclear vesicle measuring when just wetted 37-28 × 18-16 μ

Hitherto, so far as I am aware, this genus of grasses was known to

VI
UROMYCES
PISI

harbour only two species of Puccinia (P. graminis and P. coronata) This is, therefore, probably a new species—(*Jour Asiatic Soc, Bengal, Vol LX, Pt II, No III, 1891, p 212*)

Species No. 102 (a), page 84.

Conf with pp 20 21

Uromyces Pisi, *Pers ?*

On Cicer arietinum, *L.—Channa.*

I obtained some good specimens of a fungus on this host, from Dumraon, gathered on 4th April There were small circular or oval brownish pustules on the leaflets, with a tendency to coalescence. They were both epi- and hypophyllous, though apparently more often hypophyllous.

The uredospores are brownish red, mostly spherical, sparsely covered with spines, and each apparently with four germ-pores (Plate I, fig 5) The dry spores, just immersed in water, measured 25-20×21-20 μ I placed some of these spores in water on the 2nd May, and they germinated freely in twenty four hours, throwing out a long, simple unbranched tube, quite colourless (fig 5, *a*) This germination a month after gathering is noteworthy. I could find no teleutospores in the specimens gathered, and as these were full grown and ready to reap, I conclude none are formed

Remarks—This may be Uredo Ciceris arietini *Grogn*, but the only reference available to me is that in Saccardo's ' Sylloge Fungorum," and here no description or measurements are given In this book it is said to be found on the leaves of the same host in the Saone and Loire provinces of France. In a recent article by Schroter on the Fungi of Servia,* he notes a uredo on †Cicer arietinum, but includes it under Uromyces Pisi, *Pers* Saccardo records the fungus in Italy, Sicily, France, Belgium, Britain, Austria, Germany, Bohemia, Switzerland, and Asiatic Siberia.

Species No 102 (b), page 84.

Uromyces Pisi, *Pers*

On Lathyrus sativus, *L—Khesari*

From Dumraon I obtained specimens of this plant bearing a Uromyces, gathered on 4th April There were numerous dark pustules round to oval or broadly linear, on the stem mostly, but also on the leaves On the latter they are apparently amphigenous The pustules contained both uredo and teleutospores, the latter in excess

The uredospores are orange red, with a tendency to brownish. They

* ' Hedwigia, ' Band xxix Heft 2, 1890

† In the original form of this sentence there was an apparent misprint which the above would seem to correct —EDITOR

FUNGI.	Commoner Rusts and Mildews of Indian Crops

VI UROMYCES PISI

are oval for the most part, spiny, and with five to six germ-pore (Plate I, fig 6, *c*) The dried spores just immersed in water measure 28-23 × 22 20 μ These spores, after lying twenty-four hours in water, had germinated freely, throwing out a single, long, unbranched tube, at the distal end of which were collected the pale reddish-brown contents, leaving the empty *spore-case dingy yellow* (*fig 6 a*) The spores now measured 25-21 × 24-21 μ I observed the uredospores germinating even as late as the middle of June, *i e*, more than two months after they were gathered

The teleutospores are more or less oval and chestnut-brown, but vary considerably in size and shape (fig 6, *d*) A nuclear space and germ-pore at the apex are clearly visible The epispore is very finely tuberculated, and not thickened anywhere as a rule, though occasionally *a slight thickening at the apex is observable A piece of stalk usually* adheres to the spore After lying some hours in water the spores measured 32-23 × 19-14 μ They refused to germinate, apparently requiring a long period of rest

Remarks.—Four species of Uromyces are recorded in Saccardo's 'Sylloge Fungorum,' on species of Lathyrus namely, U Fabæ, *Pers*, U Pisi, *Pers*, U Lathyrinus, *Speg.*, and U. polymorphus, *P. & C* The Indian species corresponds fairly closely with U. Pisi, and may, at any rate provisionally, be classed with it At the same time no Æcidium on any species of Euphorbia is yet known in the plains of India, though such might be found on search In the description of the fungus on Cicer arietinum mention was made of Schroter's article on "Servian Fungi," and I observe that he includes a Uredo and Uromyces on Lathyrus latifolius also under U Pisi; in other words the two fungi on Cicer and Lathyrus are, according to him, identical The characters of the uredospores, as I have described them above, agree closely enough to warrant the assumption that they are identical, the only difference being that whilst I could find only four germ pores in the uredospores from Cicer I found five to six in those from Lathyrus. But this point is difficult to be very certain about—(*Journal of Botany, Vol 28, of 1890*)

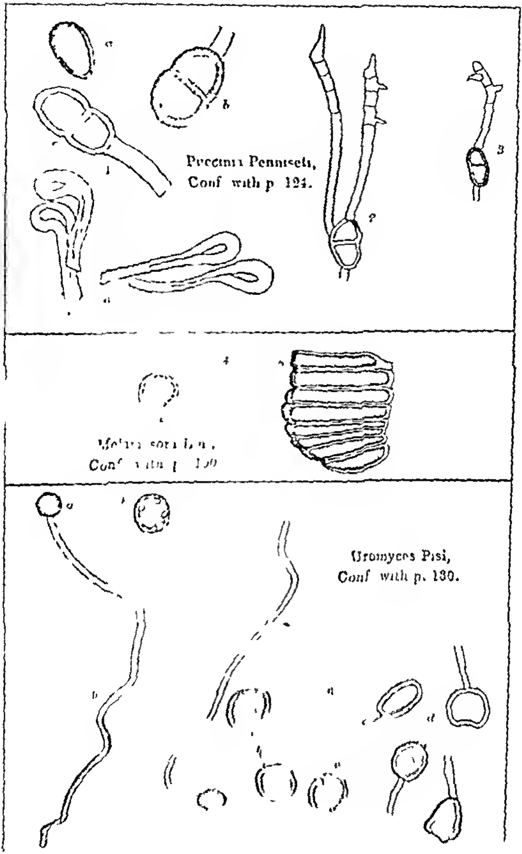
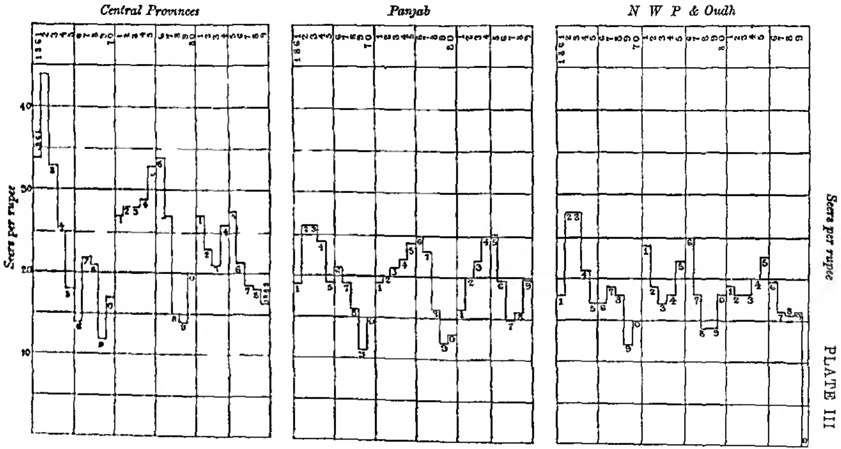

Puccinia Penniseti,
Conf. with p. 124.
Uromyces Pisi,
Conf. with p. 130.

PLATE III

Prices of Wheat from 1861 to 1889—See page 89.



INDEX.

The words in thick type are the names of Genera of Fungi: the words in Italics are vernacular names.

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C. I. C. P. O.—No. 354 R & A—22 6-96.—2,100—W. B G.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series, those on Forestry in the Forest Series Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

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THE

AGRICULTURAL LEDGER.

1895—No. 22.

OXEN AND BUFFALOES.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., O. 551–94.*]

THE CATTLE OF HARRIANA AND SIRSA.

Note by VETERINARY CAPTAIN H. T. PEASE, F.Z.S., *Civil Veterinary Department.*

Other PAPERS that may be consulted:

Agricultural Ledger 1894, No. 14; 1895, Nos. 7, 10, 12 and 19.

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1896.

The *objects of* THE AGRICULTURAL LEDGER *are*:—

(1) To provide information connected with agriculture or with economic products in a form which will admit of its ready transfer to ledgers;

(2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary) in all offices concerned in agricultural subjects throughout India, so that references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept;

(3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein,

(4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

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THE CATTLE OF HARRIANA AND SIRSA.

Note by VETERINARY CAPTAIN H. T. PEASE, F.Z.S., *Civil Veterinary Department.*

ROHTAK DISTRICT—HARRIANA CATTLE.

Divisions of the tract.

It is deemed advisable to preface this note by indicating very briefly the names, by which the great divisions of the country in this part are known to the people, as the cattle are constantly referred to by the ryots, of being from these various divisions, so that, to an ordinary individual to whom the divisions are not known, but little is conveyed by the information given. For facility of reference, therefore, the divisions are as follow:—

(1) *Harriana Bangar or Des*—means the tract to the east of the [illegible] of the Rohtak district.

(2) T [illegible] the Ghaggar valley and [illegible]

(3) T [illegible] south of the Nali or [illegible] it meets Marwar. It [illegible] nearly to Bhawalpur.

(4) T [illegible] between the Ghaggar [illegible] Malwa is considered to [illegible], which is now inhabit-[illegible]

(5) *The Nai Nadi (up-country) or Hither*—is the tract lying below the Danda all along the river Satlej.

Early Jat tents.

wa[illegible] of [illegible] gr[illegible] in[illegible] Chauhan, [illegible] search of g[illegible] habit of dr[illegible] sometimes [illegible] herds into [illegible] drove their cattle into the Satlej lowlands for pas[illegible] [illegible] villages of

Harriana—or the green country comprises about [illegible] and the greater [illegible] the Hissar district chiefly in the Hissar and Hansi tahsils and the [illegible] in the Hissar part of the Rohtak district. The part of the tract [illegible] district as described in the Gazetteer embraces two [illegible] perhaps what we technically described as *dakar* and *rausli*, or [illegible] should term loam and sandy loam. The soil is largely [illegible]

OXEN	Cattle of Harriana

ROHTAK DISTRICT.

patches of sand and water lies at great depth The climate is dry and healthy away from the canals, the yearly rainfall being small and almost entirely confined to the rainy season

This tract has long been known and justly celebrated for the excellence of the cattle it produced In former times nearly the whole of the country was jungle or uncultivated land producing in years when ordinary rain fell, an extensive growth of natural pasture grasses such as *dub* (Cynodon Dactylon), *anjan* (Pennisetum cenchroides), *sanwak*, etc., the inhabitants were a more or less [illegible] nsiderable herds of cattle. The excellen[illegible] ascribed to the facts that the soil and [illegible] le breeding and rearing, to the excellence of the natural pasture and to some amount of judgment in breeding and the general management of the herds Great numbers of cows were kept. Bulls of superior stock were released as an act of piety by those whose relatives died, and care was taken to have suitable bulls with the herds The young male stock was early castrated Added to this we have the fact that times of scarcity were of no infrequent occurrence The scantiness and uncertainty of the rainfall made life very precarious as regards water. When the rains failed, not only did the grass dry up, but the ponds become brackish and cattle perished in [illegible] seasons the people did [illegible] ee days, and no doubt [illegible] whilst the more robust [illegible] nduring great hardships [illegible] be no doubt as to the [illegible] the decline of which, especially at the present ti[illegible] ter for regret Of late years, owing to increase of the population and the consequent extension of cultivation, the extensive breaking up of even the *shamilat* lands originally designed for grazing grounds, cattle breeding has suffered very greatly and is decidedly on the decline, so that we find less attention given to the subject than formerly, was the case This is the opinion of every Agriculturist and other native I have spoken to on the subject To show the effect, which retention of waste as grazing land has on cattle-bre[illegible] on 28 villages [illegible] settlement ⅛th of [illegible] pasturage and cattle increased 92 per cent under the settlement [illegible] occupation as [illegible] al adopted by [illegible] when pasture [illegible] at present, in [illegible] as a billiard [illegible] be still fed

From a comparison of the census of cattle for the Rohtak district it will be seen that the numbers have by [illegible] and it is difficult therefore to unde[illegible] the wane, but it is nevertheless the [illegible] numbers of cattle kept are still very [illegible] (old division) and in Hansi In Jh[illegible] ing into consideration the size of the villages and the eastern villages also contain great numbers. Speaking generally I should say that the better class of indigenous cattle are found in the north western corner of the Rohtak district parts of Bhiwani and Hansi In the southern portion of the Rohtak district the cattle are very good too especially about Beri, Chuchakwas Jahazgarh and some of the neighbouring villages But the whole tract is a cattle raising country of no mean order The extension

and Sirsa.	(*H. T. Pease.*)	OXEN.

ROHTAK DISTRICT.

necessity for selling off young stock at an early stage of their existence is more urgent. The effect of bringing land under cultivation provided that the land remains "*barani*" has, of course, not such a prejudicial effect on cattle breeding as has the introduction of irrigation. The chief crops grown on *barani* [illegible] of storeable [illegible] ple [illegible] o a [illegible] in [illegible] ber [illegible] of rearing them. The number of cattle does not decrease apparently.

breeding carried on, as so great an area of the land is *barani* or dependant on rain and therefore produces only such crops as necessarily yield a considerable quantity of fodder, *jowar*, *bajra*, gram, etc., etc., and bears grass very suitable for fodder during a considerable period of the year whilst it is uncropped.

Production of Cattle.—The whole of the tract produces a number of cattle greatly in excess of requirements and must be looked upon as a [illegible] listricts in the Panjab and [illegible] eding has been completely [illegible] in which the physical cha-

[illegible] the cattle, it is [illegible] purchased by [illegible] ence they are

OXEN	Cattle of Harriana

ROHTAK DISTRICT.

patches of sand and water lies at great depth The climate is dry and healthy away from the canals, the yearly rainfall being small and almost entirely confined to the rainy season

This tract has long been known and justly celebrated for the excellence of the cattle it produced In former times nearly the whole of the country was jungle or uncultivated land producing in years when ordinary rain fell, an extensive growth of natural pasture grasses such as *dub* (Cynodon Dactylon), *anjan* (Pennisetum cenchroides), *sanwak*, etc, the inhabitants were a more or less pastoral people maintaining considerable herds of cattle The excellence of the cattle generally may be ascribed to the facts that the soil and climate are very suitable for cattle breeding and rearing, to the excellence of the natural pasture and to some amount of judgment in breeding and the general management of the herds Great numbers of cows were kept Bulls of superior stock were released as an act of piety by those whose relatives died and care was taken to have suitable bulls with the herds The young male stock was early castrated Added to this we have the fact that times of scarcity were of no infrequent occurrence The scantiness and uncertainty of the rainfall made life very precarious as regards water. When the rains failed, not only did the grass dry up but the ponds become brackish and cattle perished in

survived, and thus a very hardy stock capable of enduring great hardships only remained. Whatever the causes there can be no doubt as to the excellence of the stock produced on the tract, the decline of which, especially at the present time, can only be a matter for regret Of late years owing to increase of the population and the consequent extension of cultivation the extensive breaking up of even the *shamilat* lands originally designed for grazing grounds, cattle breeding has suffered very greatly and is decidedly on the decline, so that we find less attention given to the subject than formerly, was the case This is the opinion of every Agriculturist and other native I have spoken to on the subject To show the effect which retention of waste as grazing land has on cattle breeding the effects of Munshi Amin Chand's revenue rates on 28 villages made in 1863 in Eastern Harriana may be noted In this settlement 4th of the area of each estate was excluded from assessment for pasturage and cattle increased 92 per cent under the settlement The ex-

falls in any one part This is out of the question almost at present, in fact in many parts the so-called grazing ground is as bare as a billiard table for many months of the year and the cattle have to be stall fed From a comparison of the census of cattle for the Rohtak district it will be seen that the numbers have by no means decreased during late years, and it is difficult therefore to understand that cattle breeding can be on the wane but it is nevertheless the fact In certain parts of the tract the numbers of cattle kept are still very great, notably in the Mahm tahsil (old division) and in Hansi In Jhajjhar too, the numbers are great taking into consideration the size of the villages and the eastern villages also contain great numbers. Speaking generally I should say that the better class of indigenous cattle are found in the north western corner of the Rohtak district parts of Bhiwani and
of the Rohtak district the cattle are very
Chaudhwas Jhajjar and some of the
whole tract is a cattle raising country of

and Sirsa. (*H. T. Pease.*) OXEN.

ROHTAK DISTRICT.

[illegible]

that the land remains "*b*[illegible] effect on cattle breeding as [illegible] crops grown on *barani* la[illegible] fodder and a good deal of [illegible] have certainly adopted th[illegible] wonderful degree and almost everywhere stacks of *jowar* are to be seen in the fields and surrounding the villages; but they sell off a great number of their stock at from 1 to 2 years old as a rule, and thus save the cost of rearing them. The number of cattle does not decrease apparently, [illegible]

[illegible] especially in canal villages; the selection of good bulls is not so carefully [illegible]

[illegible] breeding carried on, as so great an area of the land is *barani* or dependant on rain and therefore produces only such crops as necessarily yield a considerable quantity of fodder, *jowar*, *bajra*, gram, etc., etc., and bears grass very suitable for fodder during a considerable period of the year whilst it is uncropped.

Production of Cattle.—The whole of the tract produces a number of cattle greatly in excess of requirements and must be looked upon as a store from which are supplied many of those districts in the Panjab and North-Western Provinces, in which cattle breeding has been completely pushed out by extensive cultivation and those in which the physical cha[illegible] [illegible] good cattle [illegible] taken by Banjaras and Banjaras also purchase through[illegible] the fairs held at [illegible] which are taken off to [illegible] then disposed of to [illegible] as many lakhs of [illegible] constant drain by [illegible] The cattle, it is said, go as far as Calcutta, especially milch cows which are purchased by Banjaras and taken to the Kosi market in Mathura whence they are taken by purchasers from this part. The accompanying statement showing the total number of cattle and area (cultivated and uncultivated) in the district of Rohtak for the years 1865, 1875, 1885 and 1893 is useful as showing the increase in numbers in the district. This gives 1 head of stock to every 4·4 acres of total area and one pair of bullocks to every 14·8 acres of cultivated land. This does not include calves or other stock.

OXEN. Cattle of Harriana

ROHTAK DISTRICT.

Statement showing total number of villages and cattle in each Tahsil, area in acres (cultivated and non-cultivated) in the District of Rohtak.

Tahsils.	Number of villages.	Area in acres: Cultivated.	Area in acres: Non-cultivated.	Area in acres: Total.	Number of Cattle: Bulls.	Bullocks †	Cows.*	Total.	Bull-calves.	Buffalo-cow.†	Buffalo-bulls	Buffalo-calves	Grand Total.	Remarks.
		1893-94.	1893-94.		1895 *	1893-94.	1893-94.							
Rohtak .	114	323,761	54,886	378,647	259	39,555	41,684	81,498	......	18,370	892	.....	......	
Gohana .	83	178,123	37,013	215,136	Information not received	25,201	21,390	46,591	......	19,480	584	..	......	
Sampla .	127	220,018	41,826	261,844	271	35,367	31,627	67,265	......	15,368	319	.....	......	
Jhajjar .	190	233,134	65,366	298,500	211	28,016	38,189	66,416	.....	8,832	571	......	......	
Total .	514	955,036	199,091	1,154,127	741	128,139	132,890	261,770	......	62,050	2,366	......	326,186	

* The statistics regarding bulls cannot be accurate. I estimate that there are at least 1,200 local bulls in the district.

† Includes calves, young stock.

and Sirsa. (*H. T. Pease.*)

OXEN.

ROHTAK DISTRICT.

Tahsils.	Area in acres.						Total number of Cows and Bullocks.			Remarks.
	Cultivated.			Non-cultivated.						
	In 1868-69.	In 1873-74.	In 1878-79.	In 1868-69.	In 1873-74.	In 1878-79.	In 1868-69.	In 1873-74.	In 1878-79.	
Rohtak . . .	......	......	295,047	......	......	80,898	......	......	22,808	
Jhajjhar . . .	......	......	234,160	......	......	66,460	......	......	19,701	
Sampla . . .	......	......	221,657	......	......	44,341	......	......	23,084	
Gohana . . .	......	......	155,158	......	......	61,629	......	......	23,130	
Total .	905,600	905,839	906,022	254,080	253,149	253,328	248,773	225,719	88,723	

OXEN. Cattle of Harriana

ROHTAK DISTRICT.

Statement showing total number of villages and cattle in each Tahsil, area in acres (cultivated and non-cultivated) in the District of Rohtak.

Tahsil.	Number of villages.	Area in acres: Cultivated.	Area in acres: Non-cultivated.	Area in acres: Total.	Number of Cattle: Bulls.	Bullocks †	Cows.*	Total.	Bull-calves.	Buffalo-cow.†	Buffalo-bulls.	Buffalo-calves	Grand Total.	Remarks.
		1893-94.	1893-94.		1895 *	1893-94.	1893-94.							
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Gohana .	83	178,123	37,013	215,136	Information not received.	25,201	21,390	46,591	......	19,480	584	...	......	
Sampla .	127	220,018	41,526	261,544	271	35,367	31,627	67,265	......	15,368	319	.....	......	
Jhajjar .	190	233,134	65,366	298,500	211	28,016	38,189	66,416	.....	8,832	571	......	......	
Total .	514	975,036	179,091	1,154,127	741	128,139	132,890	261,770	......	62,050	2,366	... ..	326,186	

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† Includes calves, young stock.

O. 551—94.

and Sirsa (*H T Pease*)

OXEN

ROHTAK DISTRICT

JAHAZGARH SPRING CATTLE FAIR 1895

Statement showing the names of districts from which the cattle sold at the fair were brought

Serial No	NAME OF DISTRICTS	Number of cattle sold	REMARKS
1	Rohtak	8 336	
2	H ssar	835	
3	Ferozepur	150	
4	Gurgaon	4 694	
5	Bikan r State	158	
6	Jh nd do.	4 269	
7	Ul var do.	1 494	
8	Jaipur do	746	
9	Delhi	1 411	
10	Khatri State	373	
11	Dujana do	1,481	
12	Loharu do	830	
13	Pat ala do	925	
14	Nabha do	634	
	TOTAL	26 336	

JAHAZGARH AUTUMN CATTLE FAIR 1895

Statement showing daily attendance of cattle, number sold fees recovered and amount changed hands

Date	Nu ber of cattle came	Number of cattle sold	Fees R a p	Amount changed hands R	REMARKS
September 10th	6 957	3 537	1 204 0 0	77 056	
Do 11th	6 262	3 065	1 391 0 0	89 024	
Do 12th	6 365	3 298	1 484 0 0	94 976	
Do 13th	5 955	2 222	1 371 0 0	87 744	
Do 14th	5 520	2 754	1 111 0 0	71 104	
Do 15th	4 870	2 2 0	866 0 0	55 424	
Do 16th	4 222	1 919	720 0 0	46 080	
Do 17th	3 240	1,583	617 0 0	39 458	
Do 18th	2 362	1 277	549 0 0	35 136	
Do 19th	2 481	1 330	5 7 0 0	33 728	
Do 20th	1 920	939	394 0 0	25 216	
Do 21st	1 146	655	203 0 0	16,832	
Do 22nd	807	337	146 0 0	9 344	
Do 23rd	100	167	60 0 0	3 840	
Do 24th	103	2	0 3 7	13	
TOTAL	52 310	25 325	10 703 3 7	6 85 005	

OXEN.	Cattle of Hariana

ROHTAK DISTRICT.

Distribution of Stock.—Cattle from this tract are purchased by three different classes of purchasers [illegible] ists. The former are chiefly [illegible] following are the receiving [illegible] Meerut, Saharanpur, Muzaffarnagar, Bulandshahr, Aligarh, Nabha, Patiala, Jeypur, Dojana, Ulwar, Dera Ismail Khan, Dera Ghazi Khan, Shahpur, Ferozepur, Amritsar Agra, Etawah, Cawnpur, Mainpuri, Etah and Rampur.

The *Roras* purchase adult stock generally selling on the "*Udhar*" system and taking payment in two *kists*, one payable in January and the other in July. They come from the Panjab Banjaras come chiefly from the North Western Provinces and purchase two classes of stock, *viz.*, small adult *animals fitted for work in light soil or sugar mills,* and *young* stock which they dispose of to cultivators and others who have grazing sufficient to meet the requirements for rearing these animals A very good idea of the distribution of the stock may be gained from a perusal of the tables under cattle *fairs*

Cattle-Fairs.

Large cattle fairs are held in the tract twice a year at Jahazgarh in the Jhajjhar tahsil of the Rohtak district, and at Bhiwani and Hissar in the Hissar district

The Jahazgarh fair is a very old established one and dates back from the time of the Jhajjhar Nawab It was originally held at Beri, but was moved to Jahazgarh some 80 years ago It was originally given out on contract for about R500, but the price steadily rose to R2,000. It came into the hands of Government in 1857 and was then let out on contract for from R3,000 to R8,000 per annum Some 25 years ago it was taken over by the district officers Since that time it has gradually improved under the fostering care of the Deputy Commissioners The [illegible]

enter the fair by one gate and sales are [illegible] ground *adjoining the entrance gate All sales are registered and a sale* ticket is given to the purchaser by the *Moharrirs*, a number of which are employed Cattle sold pass on to the ground near the exit gate and are there picketed if necessary When animals enter the ground a ticket is given to the owner, and no man can take an animal out of the fair ground unless he either has *the entrance ticket or the sale ticket*; this prevents cattle stealing Disputes are settled by the Tahsildars and Zaildars by arbitration generally to the satisfaction of all concerned. The sanitary arrangements are very good indeed, numbers of sweepers being employed A veterinary assistant is in constant attendance with a supply of medicines provided by the *District Board. A hospital for the* reception of cases of animals suffering from contagious diseases is established Altogether the arrangements are perfect and the fair is undoubtedly the best managed and most attractive in the tract. The figures and records connected with the fair are as follows:—

JAHAZGARH SPRING CATTLE FAIR, 1895.

Statement showing the number of cattle exhibited at the cattle fair

Bullocks	Cows	Buffaloes Female	Buffaloes Male	Camels	Horses	Mares	Goats	Donkeys	TOTAL.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	1	[illegible]

and Sirsa. (*H. T. Pease.*) OXEN.

ROHTAK DISTRICT.

JAHAZGARH SPRING CATTLE FAIR, 1895

Statement showing the names of districts from which the cattle sold at the fair were brought.

Serial No.	NAME OF DISTRICTS.	Number of cattle sold.	REMARKS.
1	Rohtak	8,336	
2	Hissar	835	
3	Ferozepur	130	
4	Gurgaon	4,694	
5	Bikanir State	153	
6	Jhind do.	4,209	
7	Ulwar do.	1,424	
8	Jaipur do.	740	
9	Delhi	1,411	
10	Khatri State	373	
11	Dujana do.	1,481	
12	Loharu do.	830	
13	Patiala do.	935	
14	Nabha do.	694	
	TOTAL .	26,336	

JAHAZGARH AUTUMN CATTLE FAIR, 1895.

Statement showing daily attendance of cattle, number sold, fees recovered and amount changed hands.

Date.	Number of cattle came.	Number of cattle sold.	Fees. R a. p.	Amount changed hands. R	REMARKS
September 10th .	6,057	3,537	1,204 0 0	77,056	
Do. 11th .	6,303	3,065	1,331 0 0	63,043	
Do. 12th .	6,305	3,228	1,464 0 0	81,970	
Do. 13th .	5,955	2,222	1,371 0 0	67,744	
Do. 14th .	5,531	2,734	1,515 0 0	71,104	
Do. 15th .	4,870	2,220	666 0 0	35,424	
Do. 16th .	4,222	1,919	720 0 0	46,000	
Do. 17th .	3,240	1,503	617 0 0	33,458	
Do. 18th .	2,502	1,277	511 0 0	35,130	
Do. 19th .	2,481	1,330	527 0 0	33,705	
Do. 20th .	1,330	913	324 0 0	25,210	
Do. 21st .	1,140	655	263 0 0	16,032	
Do. 22nd .	807	337	146 0 0	9,344	
Do. 23rd .	100	167	60 0 0	3,640	
Do. 24th .	103	2	0 3 7	13	
TOTAL .	52,310	25,325	10,703 3 7	4,83,005	

OXEN.

ROHTAK DISTRICT.

Cattle of Harriana

JAHAZGARH AUTUMN CATTLE FAIR, 1895

Prices. From	Prices. To	Number of cattle sold.	Remarks
R	R		
10	20	2,971	
20	30	2,495	
30	40	2,892	
40	50	3,693	
50	60	5,429	
60	70	2,950	
70	80	2,181	
80	90	1,768	
90	100	807	
100	110	83	
110	120	45	
120	130	4	
130	140	7	
	TOTAL .	25,325	

Statement showing the names of the districts from which the cattle sold at the Jahazgarh Autumn Fair were brought in 1895.

Serial No.	Name of Districts.	Number of cattle sold	[illegible] or adult.	Remarks.
1	Rohtak . . .	2,691	[illegible]	
2	Hissar . . .	4,53[illegible]		
3	Firozepur . . .	[illegible]		
4	Gurgaon . . .	4,[illegible]	[illegible]	
5	Bikanir . . .	[illegible]		
6	Jhind . . .	4[illegible]		
7	Ulwar . . .	[illegible]		
8	Jeypur . . .		[illegible]	
9	Delhi . .			
10	Khartarl .			
11	Dujana			
12	[illegible]			
13	[illegible]			
14	[illegible]			
15	[illegible]			
16	[illegible] .	[illegible]		
17	[illegible]	[illegible]		

O. 551—91.

and Sirsa. (*H. T. Pease.*)

OXEN.

ROHTAK DISTRICT.

JAHAZGARH AUTUMN CATTLE FAIR, 1895.

Statement showing the districts to which the cattle, including buffaloes purchased in the Fair, were taken.

Serial No.	Name of District.	Number of Cattle Purchased.			Breeds and by whom taken.	Class.	Remarks
		Autumn Fair, 1895.	Spring Fair, 1895.	Total.			
1	Aligarh	2,742	4,069	6,811	Bondh, Mewati, Harriana, Bagar, Bikanir, a few Marwari chiefly by dealers.	Small.	
2	Muzaffarnagar	2,735	3,339	6,074		Medium.	
3	Meerut	2,913	2,353	5,266		Do.	
4	Saharanpur	3,820	3,145	6,965		Do.	
5	Bulandshahr	4,167	3 900	8,067		Small.	
6	Etawah	281	941	1,222		Do	
7	Kurnal	337	81	418		Medium.	
8	Muthra	121	.	121		Small.	
9	Delhi	653	227	880		Medium.	
10	Hissar	534	36	570		Good	
11	Gurgaon	1,105	163	1,268		Medium.	
12	Moradabad	1,199	1,475	2,674		Small.	
13	Rohtak	895	865	1,760		Good.	
14	Cawnpur	35	1,573	1,608		Small.	
15	Agra	31	44	75		Do.	
16	Budaon	43	81	124		Do	
17	Bikanir	14	5	19		Medium.	
18	Ulwar	368	57	425		Do.	
19	Jaipur	728	47	775		Do.	
20	Khaitari	168	6	174		Do.	
21	Luharoo	176	55	231		Do.	
22	Patiala	640	170	810		Do.	
23	Dujana	258	93	351		Do	
24	Pataudi	159	25	184		Do.	
25	Nabha	105	74	179		Do.	
26	Ferozepur	29	11	40		Good.	
27	Jhind	198	123	321		Medium.	
28	Ludhiana	27	21	48		Good.	
29	Amballa	204	461	665		Medium and small.	
30	Etah	41	1,300	1,341		Small.	
31	Unknown	563	267	830			
32	Mainpuri	14	.	14		Small.	
33	Amritsar	16	23	39		Medium.	
34	Jullandhar	6	...	6		Do	
35	Dera Ismail Khan	..	437	437		Good.	
36	Shahpur	...	394	394		Do.	
37	Bannu	...	231	231		Do.	
38	Dera Ghazi Khan	...	193	193		Do.	
39	Faridkote	...	40	40		Do.	
40	Gujranwalla	..	11	11		Do.	
	TOTAL	25,325	26,336	51,661			

OXEN.	Cattle of Harriana
ROHTAK DISTRICT.	JAHAZGARH AUTUMN CATTLE FAIR, 1895

Prices. From	Prices. To	Number of cattle sold.	Remarks
R	R		
10	20	2,971	
20	30	2,495	
30	40	2,892	
40	50	3,693	
50	60	5,429	
60	70	2,950	
70	80	2,181	
80	90	1,768	
90	100	807	
100	110	83	
110	120	45	
120	130	4	
130	140	7	
	TOTAL .	25,325	

Statement showing the names of the districts from which the cattle sold at the Jahazgarh Autumn Fair were brought in 1895.

Serial No.	Name of Districts	Number of cattle sold	Young or adult.	Remarks.
1	Rohtak . . .	2,601	Chiefly adult.	Harriana.
2	Hissar . . .	4,530	Adult.	Ditto
3	Firozepur . . .	52	Do	Jangle.
4	Gurgaon . . .	4,067	Do	Mewati and Harriana.
5	Bikanir . . .	35	Do.	Bikanir.
6	Jhind . . .	4,328	Do.	Bondh and Bagar.
7	Ulwar . . .	3,741	Do.	Mewati.
8	Jeypur . . .	887	Do.	Marwari.
9	Delhi . . .	946	Do.	*Desi.*
10	Khaitari . . .	221	Do.	
11	Dujana . . .	777	Do.	Parbatsari (cattle like Harriana)
12	Luharu . . .	940	Do.	Ditto
13	Patiala . . .	903	Do	Harriana and Bagar.
14	Nabha . . .	559	Do.	Ditto.
15	Kurnal . . .	75	Do.	Baogar.
16	Jodhpur . . .	69	Do	Nagori.
17	Pataudi . . .	194	Do.	Harriana.
	TOTAL .	25,325		

ROHTAK DISTRICT.

Jahazgarh Autumn Cattle Fair 1893.

Statement showing the districts to which the cattle, including buffaloes purchased in the Fair, were taken.

Serial No.	Name of District	Number of cattle purchased. Autumn Fair, 1893.	Spring Fair, 1893.	Total.	Breeds and by whom taken	Class	Remarks
1	Aligarh	2,742	4,069	6,811	Hondh, Mewah, Hurrana, Bagar, Bikanir, a few Marwari chiefly by dealers.	Small.	
2	Muzaffarnagar	2,735	3,339	6,074		Medium.	
3	Meerut	2,013	2,353	5,206		Do.	
4	Saharanpur	3,820	3,145	6,965		Do	
5	Bulandshahr	4,167	3,900	8,067		Small.	
6	Etawah	231	941	1,222		Do	
7	Karnal	337	81	418		Medium.	
8	Muthra	121		121		Small.	
9	Delhi	653	237	890		Medium.	
10	Hissar	534	36	570		Good	
11	Gurgaon	1,103	163	1,268		Medium	
12	Moradabad	1,199	1,475	2,674		Small.	
13	Rohtak	893	865	1,760		Good	
14	Cawnpur	35	1,573	1,608		Small.	
15	Agra	31	44	75		Do.	
16	Budaon	43	81	124		Do	
17	Bikanir	14	5	19		Medium.	
18	Ulwar	368	57	425		Do.	
19	Jaipur	729	47	775		Do	
20	Khaitari	168	6	174		Do	
21	Luharoo	176	55	231		Do	
22	Patiala	640	170	810		Do.	
23	Dujana	238	93	331		Do	
24	Pataudi	159	25	184		Do.	
25	Nabha	105	74	179		Do.	
26	Ferozepur	29	11	40		Good.	
27	Jhind	198	123	321		Medium.	
28	Ludhiana	27	21	48		Good.	
29	Amballa	204	461	665		Medium and small.	
30	Etah	41	1,300	1,341		Small.	
31	Unknown	563	267	830			
32	Mainpuri	14		14		Small	
33	Amritsar	16	23	39		Medium.	
34	Jullandhar	6	...	6		Do.	
35	Dera Ismail Khan	..	437	437		Good.	
36	Shahpur	...	394	394		Do	
37	Bannu	..	231	231		Do.	
38	Dera Ghazi Khan	..	193	193		Do.	
39	Faridkote	..	40	40		Do.	
40	Gujranwalla	.	11	11		Do	
	TOTAL	25,325	26,336	51,661			

OXEN.

ROHTAK DISTRICT.

Sampla Tahsil.

Rohtak Tahsil.

Cattle of Harriana

Sex.	Age.	Height at shoulder.	Height at croup.	Height at elbow.	Length.	Length of horn.	Length of ear.	Length of face.	Breadth of forehead.	Girth at chest.	Girth at abdomen.	Girth of forearm.	Girth of shank.	Length of neck.	Length of shank.	Colour of skin.	Colour of hair.	Remarks.
									Cart Bullocks, good, Sampla.									
Bullock . .	12	58	59	30	48	9	11	23	7	75	85	17	7	23	6	Black	White.	
" . .	6	59	61	30	44	11	11	22	7	75	84	18	8	23	6	"	Grey.	
" . .	6	59	62	31	44	10	11	22	7	78	87	18	8	24	7	"	White.	
" . .	8	60	62	31	48	8	11	23	7½	84	96	17	8	23	6	"	"	
" . .	8	58	60	30	46	14	9	22	7	74	91	18	7½	20	6	"	Grey.	
" . .	7	57	60	31	47	12	10	23	7	77	90	17	8	21	6	"	"	
									Measurements, etc., of the Plough Bullocks, Rohtak Tahsil.									
Bullock . .	3	53	54	30	46	6	10	20	6½	73	87	16	7	20		Black.	Grey.	
" . .	8	58	59	30	47	15	12	23	7	77	96	17	8	22		"	"	
" . .	8	57	59	31	47	14	11	23	7	78	96	17	8	22	7	"	"	
" . .	5	56	58	31	45	7	10	1	7	70	86	17	8	21	7	"	"	
" . .	6	56	58	30	45	12	10	21	7	70	85	16	8	21	7	"	"	
" . .	8	57	58	30	49	12	10	22	7	77	94	17	7	22	7	"	"	

and Sirsa (H. T. Pease.)

OXEN.

ROHTAK DISTRICT.

Sex.	Age.	Height at shoulder	Height at croup.	Height at elbow	Length.	Length of horn.	Length of ear.	Length of face.	Breadth of forehead.	Girth at chest.	Girth at abdomen.	Girth of forearm	Girth of shank	Length of neck	Length of shank.	Colour of skin.	Colour of hair.	Remarks.
								Sampla Tahsil										Sampla Tahsil.
Bullock . .	7	56	59	28	42	16	16	20	7	71	86	15½	7	19	6	Black.	White	
,, . .	6	57	59	28	42	15	21	7	7	72	85	16	7	21	6	,,	,,	
,, . .	3	54	55	28	41	6	20	6	8	66	76	15	6½	18	6	,,	,,	
,, . .	5	57	59	30	43	8	21	7	10	73	85	16	7	22	6	,,	Grey	
,, . .	8	57	59	30	44	16	22	7½	10	79	88	17	7	22	6	,,	White	
,, . .	4	56	58	31	44	9	23	7	11	75	85	17	7	23	6	,,	Grey	
Measurements, etc., of the Harriana in Rohtak Tahsil, Good Cows																		Rohtak Tahsil.
Cow . .	7	57	58	28	38	8	9	19	6	68	81	15	6	19	7	Black	Grey	9 seers milk.
,, . .	11	55	54	31	46	8	9	20	7	66	80	16	7	21	7	,,	,,	8 ,, ,,
,, . .	5	54	53	30	44	8	8	20	6½	64	79	16	6½	22	7	,,	,,	8 ,, ,,
,, . .	5	56	57	31	45	8	9	20	6½	69	81	16	7	22	7	,,	,,	9 ,, ,,
,, . .	6	53	55	30	44	10	9	20	6½	67	79	16	7	21	7	,,	,,	9 ,, ,,
,, . .	12	51	53	29	36	9	9	19	6½	63	88	15	6	21	6	,,	,,	10 ,, ,,
								Sampla Tahsil										
Cow . .	6	51	55	27	35	9	10	19	5½	64	77	13	6	20	6	,,	,,	7 seers milk
,, . .	7	50	51	27	40	9	9	20	6	64	80	13	6½	20	6	,,	,,	5 ,, ,,
,, . .	7	53	54	27	42	12	10	21	6½	64	81	14	6½	21	6	,,	,,	8 ,, ,,
,, . .	7	51	53	27	43	4	8	19	6	62	80	13	6	20	6	,,	,,	5 ,, ,,
,, . .	6	51	53	27	41	8	10	20	6	63	79	14	6	20	6	,,	,,	7 ,, ,,
,, . .	4	49	50	26	41	8	9	20	6	62	72	13	6	20	6	,,	,,	5 ,, ,,

OXEN.	Cattle of Harriana
ROHTAK DISTRICT.	*Grazing.*—The breaki- ment of the grazing area already been alluded to fairly extensive In other parts, however, the village waste is nothing more than an exercise ground, as Dr. Voelcker puts it, there being not a blade of grass excepting for a short time during and after the rains. Given good seasonable rain, however, there is no lack of grazing excepting from April to June when the grass is always scanty. On the *barani* lands where the crops are dependent on the rains and which form perhaps 60 per cent. of the cultivated area in the Rohtak district a good on which the cattle can graze over it without distinction* The the eastern side of the Rohtak tahsil and crosses the Jhajjhar sub-division obliquely in a south-easterly direction is covered in parts by a sparse growth of *dub* and other grasses which afford a considerable amc attle especially in the southern part belonging to Government in the ir Jhajjhar, another at Dadri and oo bighas Great numbers of cattle are driven to these in the rains. These reserves are a valuable resource in times of dearth and I was pleased to see a good deal of hay stacked in them as a provision against a year of scarcity. Cattle breeding naturally flourishes in their vicinity as may be gathered from the fact that the small village of Islamgarh which is on the edge of the *bir* and head of cattle in are sent to graze tle of the villages ges still have fair r vicinity I was being broken up. been noted in the appen- In times of scarcity the jungles of Kurnal,
	Grasses district is *du* all the year spring up during the rains are chiefly *anjan* (Pennisetum cenchroides) an excellent fodder grass, *Lamp* (Aristida depressa) good *Palwa* (Andro-
	is carefully stored in stacks called *chhur* or *kraals* (*gatwara*) either immediately outside the villages or in the fields in the northern parts of the district *Guar* (Cyamopsis psoraloides) appears to be the only crop generally grown specially for cattle It is sometimes sown with *juar*

* In Vol VII, p. 183, Fl. Br. Ind., Sir J. D. Hooker refers this plant to the genus Andropogon under the above name which should now be given for the *juar* instead of the familiar sorghum and vulgare.—*Ed*

and when the latter is cut some of the *guar* is fed off, the seed of the remainder being collected when ripe and given ground and boiled or mashed to young bullocks and calves. The *bhus* of gram is also used In irrigated tracts there is also the *bhus* of wheat which is stacked in heaps (*koop*) and fed to cattle, where sugar cane is grown cattle get the leaves and eat a fair quantity also of the cane after the juice has been expressed. T[illegible] nummula. [illegible] and is oft[illegible] chopped [illegible] fields are [illegible] carefully [illegible] to have [illegible] bushes ar[illegible] fence in the cropped fields.—*Pala* sells in times of scarcity at 20 seers and at ordinary times at 2 to 3 maunds the rupee. If fed to excess it produces a skin eruption above the hocks inside the thighs locally known as *jai*. Altogether considerable stores of fodder are to be seen [illegible] been made to [illegible] although there [illegible] mortality in a [illegible] cattle present in the district.

Feeding.—[illegible] ing all over the [illegible] cake and *binou*[illegible] They get about [illegible] gram and wheat or barley mixed with *pala*. A pound or two of cake, *khall*, and about a seer of cotton seed, *binoula*. The favourite mixture all [illegible] in small [illegible] If *guar* [illegible] *kutti* or [illegible] are tied up for the night.

Bullocks get *sani* or *kutti* and gram and *bhus* with *pala* regularly. It is estimated that to stall feed cattle properly would cost about 4 annas a day each at the following rates:—

Bhusa or *juar* and *pala*, 2 annas at 3 maunds per rupee.
Gram . . . . . 1 anna at 32 seers per rupee.
Cotton seed and *khall* . 1 anna at 16 seers per rupee.

Cotton seed is considered to be heating and is only given during the cold weather, *khall* being substituted in the hot season. The cattle are entirely stall fed during the rains and require less when grass has sprung up after them. I should estimate that the cost of feeding to the zamindar would be about 2 annas a day average.

Prices of Cattle.—I gather from the people that cattle have risen considerably in value during the last 20 years, and there appears to be every probability of a further rise as decrease in cattle breeding in other districts continues. The rise may be attributed to (1) the increased cost in production owing to curtailment of the grazing area due to the grazing grounds and jungle having been brought under cultivation, (2) to increased demand in districts where the production has fallen much below the requirements, (3) to money having become cheaper.

OXEN.	Cattle of Harriana
ROHTAK DISTRICT.	

There are now few places where cattle have not to be stall fed during some part of the year, and in most places they receive food in addition to what they can pick up grazing all the year round with the exception perhaps of the two months when grass springs up after the rains

Ordinary good plough bullocks fetch from R120 to R160 per pair, Majholi bullocks R200 to R300 per pair, Cows from R25 to R80, Calves from R12 to R60 according to quality and age

Supply of Bulls.—In the lower parts of the district in the Jhajjhar tahsil efforts were made some years ago to improve the indigenous breed of cattle by the introduction of pure-bred Nagori bulls, and the distribution of these for the use of the villages around Chhuchakwas where the Nawab of Jhajjhar had his *aish bau* Doubtless some improvement in quality was effected by this means, and if the practice had not come to an abrupt conclusion, we should have had more marked results than are to be seen at present The father of the present Raja Kalyan Singh also imported a small herd of Nagori cattle from Jodhpur into Jahazgarh, and the young [illegible]

[illegible] Jahazgarh, Mohamedpurmajra, [illegible]

[illegible] t of it, formerly belonging to the Nawab of Jhajjhar, have run wild (*rana dangar*) in the Chhuchakwas *bir*, I managed to get within about forty yards of a herd there They are fine cattle and have doubtless been joined by some village cattle as well. The bulls have occasionally covered village cows and one of the [illegible]

[illegible] Nagor 1, Gaddi Namdar Khan 1 in the Gohana tahsil.

Bahana 1 old, Chuliana 2 old, Kalawar 1 old, in the Sampla tahsil. Patwapur 1, Basana 1 in Rohtak [illegible] appears to be [illegible] These three [illegible] e the breed of cattle by the importation of foreign bulls

Local or Brahmini Bulls.—Local bred bulls are those which have already been described. They are turned loose when about a year or more old by Hindus on religious grounds at the death of a relative: they are branded usually with Mahadeo's *trisul* shaped like a trident on one quarter and Vishnu's *chakar* on the other, and from the time they are [illegible] usually fed by the family who have offered [illegible] ten they go out to graze, and are [illegible] crops in the cultivated fields; as [illegible] is to drive them off his land if they [illegible] generally come up to the village [illegible] receive some food from the people. [illegible] very docile, many of these bulls are splendid animals [illegible] l specimens of the indigenous breed are in every respect the most suitable animals which could be found to keep up the excellence of the cattle of the tract. In villages where Hindus predominate, especially on *biram* lands there is generally no lack

ROHTAK DISTRICT.

of good bulls especially where there are a few wealthy families, but in Rangbar villages there [illegible]
their cows covered by [illegible]
or Jat villages. These [illegible]
the custom of turning [illegible]
into disuse, and it was [illegible]
to turn one loose. A [illegible]
and becomes more mixed, the liberties allowed to these animals in the way of grazing on cultivated fields naturally become restricted and the people, especially Mahomedans, do not content themselves with simply driving them off their fields, but occasionally use a *lathi* or a *kulhari* by way of a persuader. I think that anything which interferes with the provision and maintenance of these animals is to be deprecated, and that any one who voluntarily causes them an injury should be severely punished. It is very evident that if the practice of releasing them cease cattle-breeding must [illegible] two or three thousa[illegible] ed by purchase and [illegible] nt of capital. The [illegible] o the villagers a goo[illegible] ng by custom that it almost amounts to a law, and considering that it is for the general good, and that by means of it alone the country has been pro- [illegible]

[illegible]

taking off three and four bulls at a time to let them loose in the eastern villages of the Rohtak district. This is a very pernicious practice, as the bulls do much harm in the herds to the cultivation This is also a common practice in the case of bad bulls and there is quite a collection of them at places like Bahadurgarh, Kharkandah, etc. The people would be very good to be relieved of these animals if they could [illegible] There [illegible] for cows [illegible]

length, is [illegible]

[illegible] ections. [illegible] obably [illegible] loose, [illegible] n when [illegible] it fails there is some trouble in obtaining a suitable bull. (5) They are soon worn out and purely on account of the amount of work they do as one bull is considered to be sufficient for one hundred and fifty cows.

The people get rid of unsuitable animals by deporting them: as has been stated they can also drive them away from the herds as a rule and

OXEN	Cattle of Hariana

ROHTAK DISTRICT

they do so where cattle breeding flourishes In some parts bulls are found in excess of the requirements, whilst in others there are not sufficient The excess is generally found in towns where wealthy Sahucars live and the deficiency in parts where the Hindus are poor and cannot afford to release bulls Thus at Chhuchakwas with 400 cows, there was only one bull, at Marot with 400 cows there were two, at Kalanour, a Ranghar village with 1,313 cows there were four, at Lali with over 200, there was no bull, etc, whilst at Beri and in some of the towns there were great numbers It is a great pity that there is not more give and take about the people, but certainly assista [illegible] illages very often It would be a very g [illegible] could in any way manage to regula [illegible] ls and I think it would be m [illegible] kind can be attempted, a more [illegible] of bulls is an absolute necessity an [illegible] the Veterinary Subordinates of the Civil Veterinary Department can be of great use in obtaining information and I [illegible] to invariably [illegible] class of stock [illegible] uniform in he [illegible] bulls and their class, whether sufficient or not (4) What grazing is available (5) Whether the people take interest in cattle breeding and feed their cattle well We shall then be able to form some idea of the requirements of the people

What must be done in case th [illegible] ***fails.***—In case of the failure in supply o [illegible] have to be made to ensure the provision [illegible] carried on It will become necessary to either supply the animals or to collect sufficient money for the purchase of bulls from the village and impose a small tax for the feeding of bull This, it is hoped, however, will not become necessary in the tract with which we are at present dealing I think it is highly advisable however, to see that every village in the tract has a good herd bull or two if necessary and for protected bulls to be introduced if found desirable for, even at the present day, some villages are badly off for bulls

OXEN.	Cattle of Harriana
ROHTAK DISTRICT.	

[illegible] are found [illegible] nt. The [illegible] and the [illegible] afford to [illegible] only one bull; at Marot with 400 cows there were two; at Kalanour, a Ranghar village, with 1,313 cows there were four; at Lali with over 200, there was no bull, etc., whilst at Beri and in some of the towns there were great numbers. It is a great pity tha[illegible] the people, but certainly assista[illegible] very often. It would be a very g[illegible] in any way manage to regula[illegible] I think it wo[illegible] kind can be attempted, a[illegible] of bulls is an absolute nece[illegible] the Veterinary Subordinates [illegible] be of great use in obtaining [illegible] n be directed to invariably [illegible] a village (1) class of stock [illegible] more or less uniform in he[illegible]) Number of bulls and their class, whether sufficient or not (4) What grazing is available (5) Whether the people take interest in cattle-breeding and feed their cattle well. We shall then be able to form some idea of the requirements of the people.

[illegible] carried on. It will become necessary [illegible] collect sufficient money for the purchase [illegible] impose a small tax for the feeding of [illegible] will not become necessary in the tract with which we are at present [illegible]

and Sirsa. (*H. T. Pease*)

OXEN.

ROHTAK DISTRICT.

Measurements, etc., of the Bulls.

Sex	Age	Height at shoulder	Height at croup	Height at elbow	Length	Length of horn	Length of ear	Length of face	Breadth of forehead	Girth at chest	Girth at abdomen	Girth of forearm	Girth of shank	Length of neck	Length of shank	Colour of skin	Colour of hair	Remarks
Bull at Jahazgarh .	7	57	59	30	43	6	10	19	9	77	89	19	9	23	6	Black.	Grey.	Nagori strain.
„ at Beri . .	15	60	62	31	44	12	10	23	11	80	92	21	9	25	7	„	„	
„ at Kalanour .	26	58	60	30	43	13	10	22	9	73	84	18	8½	26	7	„	„	
„ at „	8	57	59	31	43	9	9	21	9½	80	90	20	8½	24	7	„	„	
„ at Bahadurgarh .	3	58	60	31	45	8	9	22	9	80	89	18	9	20	7	„	„	
Good bulls at Farmana .	4	58	60	30	44	9	10	22	9	79	87	18	9	20	6	White.	White.	
„ „ .	5	61	64	32	48	10	10	24	10	85	94	22	9	25	7	Black.	Black. White.	
Small bulls at Sampla .	10	50	51	27	40	3	6	20	7	71	81	18	8	21	6	...	...	Inferior.

OXEN.	Cattle of Harriana

ROHTAK DISTRICT.

are found
nt. The
and the
deficiency in parts where the Hindus are poor and cannot afford to release bulls. Thus at Chhuchakwas with 400 cows, there was only one bull; at Marot with 400 cows there were two; at Kalanour, a Ranghar village, with 1,313 cows there were four; at Lali with over 200, there was no bull, etc., whilst at Beri and in some of the towns there were great numbers. It is a great pity that
the people, but certainly assista
very often. It would be a very g
in any way manage to regulate the distribution of these animals and I think it would be managed. But before anything of the kind can be attempted, a
absolute neces
Subordinates
in obtaining in
to invariably
class of stock
uniform in heig
bulls and thei
available (5) Whether the people take interest in cattle-breeding and feed their cattle well We shall then be able to form some idea of the requirements of the people.

impose a small tax for the feeding of
will not become necessary in the tract with which we are at present
however, to see that every village in
necessary and for protected bulls
, even at the present day, some

O. 551—94

and Sirsa. (*H T. Pease*) OXEN

ROHTAK DISTRICT

Measurements, etc, of the Bulls

Sex	Age	Height at shoulder	Height at croup	Height at elbow	Length	Length of horn	Length of ear	Length of face	Breadth of forehead	Girth at chest	Girth at abdomen	Girth of forearm	Girth of shank	Length of neck	Length of shank	Colour of skin	Colour of hair	Remarks
Bull at Jahazgarh	7	57	59	30	43	6	10	19	9	77	89	19	9	23	6	Black.	Grey	Nagori strain.
„ at Beri .	15	60	62	31	44	12	10	23	11	80	92	21	9	25	7	„	„	
„ at Kalanour	26	58	60	30	43	13	10	22	9	73	84	18	8½	26	7	„	„	
„ at „	8	57	59	31	43	9	9	21	9½	80	90	20	8½	24	7	„		
at Bahadurgarh .	3	58	60	31	45	8	9	22	9	80	89	18	9	20	7	„		
Good bulls at Farmana	4	58	60	30	44	9	10	22	9	79	87	18	9	20	6	White.	White	
„	5	61	64	32	48	10	10	24	10	85	94	22	9	25	7	Black	Black White	
Small bulls at Sampla .	10	50	51	27	40	3	6	20	7	71	81	18	8	21	6			Inferior

OXEN	Cattle of Harnaoa

ROHTAK DISTRICT.

Government Bulls.—As has already been stated, some bulls bred at the Government Cattle Farm at Hissar have been distributed in the district with a view to improving the breed of cattle in it The practice of using them has, however, fallen into disuse. It has been stated by the district authorities that the people do not appreciate them. I have made numerous enquiries into the matter ...

sar farm establ ...

for Artillery an ...

sequence is the cattle seen are almost without exception crosses of various descriptions The Hissar Farm bred animal, even the so-called pure bred ... uitable than the ordinary ... cepting in certain parts of ... have all the faults they ... ears, large sheath, carcase large, heavy and loosely put together, sprawling feet, besides the appearance of being soft and sluggish They are also in addition to all this *doglas* or cross bred ... obtained indiscriminately f ... crossed *of all degrees to* s ... gole, (3) Nagore Sind, (4) N ... Nagore, (7) Mysore Angole, (8) Gujrat Harriana, (9) Gujrat Nagore, (10) Gujrat Angole, (11) Gujrat Mysore, (12) Nimar Mysore. Doubtless these animals may be useful for the service they are bred to render, but the distribution of such animals in a really good cattle-breeding district is a measure which is open to a good deal of criticism

What are we to say of the present system if there be any real system at all Is any one aware of the capabilities of the various portions of the ... favourable, class of ... e questions of im- ... take with regard ...

Such a method of procedure is absolutely opposed to all the principles of rational breeding, and by adopting it when dealing with a fairly good breed we are hastening destruction by producing non-descript mongrels We know as the result of experience that "dashing" a pure breed with a cross bull, no matter how much better he may appear to be, is a dangerous experiment, and one not likely to be attended with very favourable results ...

the breed. ...

to get the br ...

the stock go ...

sit down w ...

or soft and sluggish and they do not care for it They usually take

ROHTAK DISTRICT.

... it shows up well when ...

... *only good specimens, and, if small ears and sheath and no ... must be taken* one half Harriana would be most suitable, such as possibly Gujrat Harriana or Nagore Harriana. I should most certainly avoid other crosses. Probably it will be found that the most suitable cross-bred animal is the Gujrat Harriana of good quality, as the Gujrat seems to nick well with Harriana. I saw a bull of this cross at Kheri Damkan and ... ere seem to like the stock as ... wn use, but they say it is not ... ny rate, it is good. There is ... Rohtak district; he is an in... re is a very inferior Gujrat ... very much disgusted with it ... supposed to be a Harriana bull at Kandrai, fair but not a good specimen. It appears that the ... ssar farm then vary very consider... none but good specimens be sent ... best plan would be to decide what ... re, and ... being ... d, suit...

... I am decidedly of the same opinion as *Professor Wallace*, namely, that by far ...

... and soil having been already adjusted, there would be a clear course ...

... arrangements could be made for rearing them properly until three or four years old, they could be turned loose with the Government brand on them and would be appreciated far more than are the bulls at present issued. ...

* This plan has since been adopted.

OXEN	Cattle of Harriana

ROHTAK DISTRICT

Where the indigenous cattle are good enough for the purpose of agriculture and command a good price in the market, it seems unnecessary to introduce bulls of any other breed, and if it be desired to really help the people with cattle-breeding and to encourage it more will be done by giving good prizes at cattle fairs and by turning loose the best indigenous young bulls obtainable, and so arranging that each village will have a sufficient number of first class bulls Spasmodic efforts, such as turning loose a few bulls of foreign breed occasionally, will not do very much good, the subject needs attacking in a thoroughly methodical manner. I know the people would be only too delighted to have good specimens of their own indigenous breed turned loose. There would of course be some difficulty in obtaining young bulls of proper age at present as the people castrate them early But prizes at fairs would doubtless soon produce a sufficient supply. I found some difficulty in tracing the Government bulls and ascertaining where they are, and when found very little stock was as a rule forthcoming owing to the custom the people have of selling it off when young, but a good deal of that which was seen was very inferior.

[illegible]

[illegible] could possibly result [illegible] have given *Mr. Blenkinsop's* letter No V, dated 23rd March 1892, to the address of the Director of Land Records and Agriculture of the Panjab considerable attention, and have come to the conclusion that the remarks made in it certainly do not apply to this district, and that any action taken in the direction indicated would only tend to make the Hissar bulls more unpopular even than they are at the present time. Seeing how little superior the Hissar bred animal is likely to be to the local bred bull, it does not appear likely that the people would trouble to keep cows up for it in the villages, and I am decidedly not in favour of stall feeding these animals here Take, for instance for the sake of example, a village with five or six hundred cows, there would be three bulls at least present—1 Hissar and 2 Brahmini The system is to drive all the cattle out to graze together, the bulls usually separating off *with a number of cows The Hissar bull is tied up, there being no work* for him to do in the village So a man has to be kept to exercise him. The people consider that covering should take place with the animals free, or a state of nature, so that there would be not much chance of his doing much work, and even if the people were willing to use him there would be every chance of the cows being bulled by the Brahmini bulls which [illegible] comes the question of cost, who is [illegible] It would be obviously unfair to sad[illegible] the only alternative is either to prov[illegible] district funds or to raise it in the village by a small tax which would, I am afraid, be a very unpopular measure The people certainly have no objection to providing food from the *Malba* or village fund for the bull when necessary, but they would certainly not care to spend money in carrying out a measure which they do not agree with nor approve of There is another point against tying the bulls up It must be remembered that these animals are bred in a state of freedom and are never tied up at Hissar and consequently if they be subjected to this treatment when sent into the districts they are likely to suffer from the confinement and will not do well From what I have seen when

and Sirsa (*H. T. Pease.*)	OXEN.
	ROHTAK DISTRICT.

these animals leave the farm at four years old or so they are in poor condition and will not look at a cow; it is not until they have been free,

or practicable here at present. There are perhaps a few cases in which it might be useful as, for instance, in towns where non-agriculturists keep considerable numbers of good cows for their milk supply. They might be induced to send their cows to a Government bull which is tied up if it be a specially good one. Then by all means tie him up and work him or do anything else that it may be considered necessary. The only question which would arise is that of cost.

I do not altogether agree with some other remarks made by this officer, especially with regard to the animals not being kept fully under control being likely to beget stock which will be more difficult to manage than that get by animals accustomed to restraint. The remark does not apply to cattle in this country as a rule and certainly not to those in the Hissar or Rohtak districts. The general treatment of cattle renders them absurdly quiet; they are in a very high state of domestication. The bulls met with, as a rule, are very quiet and one sees the cow-herd lads petting them and driving them about and to meet with a vicious

wild, so I do not see the application.

Mr. Blenkinsop also remarks that the bulls get insufficient exercise and therefore do not get stock. These animals get far more exercise, being driven out daily to graze and coming up with the cattle in the

by these animals is that there is a want of continuity of action by the

more in request, the reason being that the young stock are larger in size and are sold off early fetching a better price than the indigenous cattle such as Fatehabad and Sirsa and parts of Hissar. But little improve-

parts where good

har and Sampla,

OXEN	Cattle of Harriana
ROHTAK DISTRICT	

to show what number of cattle perished As much as possible is done to persuade the people to store fodder for cattle against a scarcity, and they certainly do store a considerable quantity, probably enough to see them over one bad year without great loss of cattle No effort should be neglected to induce the people to maintain a good store, as although the district produces cattle far beyond its requirements we must not lose sight of the fact that there are many districts dependent on the excess production of this tract for their agricultural draught cattle The insufficiency of the grazing area has already been mentioned

Sale of Cows —I think every effort should be made to foster cattle-breeding by inducing the people to retain their good cows for breeding purposes Colonel Rennick I am informed did generally advise the people *in this matter and attempted to dis ourage the sale of good cows to* butchers at tl
a district of t
proverb amc
on their own
as h des "
get rid of and they would suit the purposes of the butcher as well as good ones

early morn ng, resting during the heat of the day The main road between Bhiwani and Delhi shows at times a constant stream of carts going and returning Well irrigation is scarcely ever seen, so the bullocks ... parts bullocks are sold
s bought to avoid the
grazing, but this is not
ocks work in the sugar
always well fed when
working and indeed at other times

Buff... celebrated for excel
lence as a
ab out the
sp rally
as *kundi* A very great proportion of the animals, however, have the horns of the shape known as *Katchha kundi* in wh ch the twist is imperfectly developed In the better bred animal the horns are small, black and spirally twisted They are considered to be the best breed of buffaloes in the Panjab for milking and are consequently valuable They are massive heavy beasts standing on short powerful legs This breed has already been described in my report on Panjab cattle The best of them in the Rohtak distri t are to be seen in the villages about Nidanah and Butanah where they are kept in great numbers Butana itself conta ns nearly a thousand buffalo-cows the neighbouring villages of Baroda 668, Bichpari 417 Ahulana 411, Jaysi 690, etc, etc These animals are more numerous in the northern villages of Gohana and to the eastward, but *the distribution of them can be best seen* by consulting the village by village census appended Ch kanwas in Hissar is also said to be a good place for them The people bestow a good deal of care on the breeding of these animals as has already been pointed

and Sirsa (*H T Pease*)	OXEN.

ROHTAK DISTRICT.

out in previous reports Good bulls are employed, generally turned loose with the herds as are Brahmini bulls The people feed them well and value them highly The young male calves are sold off as soon as possible, the people do not use them for any kind of work and they are reared in a state of semi starvation, being looked upon as a nuisance They are sold off to *beparis* who come round purchasing in the district and who take them northwards where they are employed as draught animals

Names—A male calf is called *katra* for 2 years then *jhotra* till four years after which *jhota* or *bhainsa*, females *katri jhotri* and *bhains*, an old one is usually referred to as *khola*.

The cows have their first calf at between 4 and 5 years and go on breeding for 9 or 10 years

Yield of Milk—This varies from 7 to 14 seers a day in ordinary [illegible]

[illegible] years they [illegible] to quality

Measurements as follows —

OXEN. Cattle of Harriana

ROHTAK DISTRICT

Measurements, etc., of the Harriana breed of Buffalo

Sex	Age.	Height at shoulder	Height at croup	Height at elbow	Length	Length of horn	Length of ear.	Length of face	Breadth of forehead	Girth at chest	Girth at abdomen.	Girth of forearm	Girth of shank	Length of neck.	Length of shank	Colour of skin.	Colour of hair	Remarks
Buffalo-cow .	10 years	55	56	29	48	19	9	24	8	87	97	19	10	19	5	Black	Black	
" .	5 "	53	55	27	41	17	8	23	7	92	103	20	10	19	5	"	"	
" .	3 "	53	52	28	45	15	12	20	9	102	110	16	10	25	12	"	"	

HISSAR DISTRICT—SIRSA CATTLE.

HISSAR DISTRICT.

General Remarks.—The area of this tract is 3,416 square miles, of which 76 per cent. is cultivated, 19 per cent. culturable and 5 per cent. barren. It is divided into three zones, the Bagar, Harriana and the [illegible]

[illegible]

ping of the Bagar is done in the *kharif* season.

[illegible]

too the *kharif* is the most important crop, but to a less extent than in the Bagar.

THE NALI TRACT, which is situated in the north of the Fatehabad tahsil, is characterized by a clay soil. It includes the villages liable to inundation from the Ghaggar and Joya streams.

The average rainfall is 16 inches and the climate is generally dry and well suited for cattle.

Grasses.—The grasses are a very important part of the vegetation of the district, having regard to the great number of cattle possessed by the [illegible]

[illegible]

dhaman.

The commonest grass is the *Ghautile* (Eleusine flagellifera) a small creeping perennial grass common on moist sandy soil. It is good fodder and is readily eaten by cattle. The *bhobra* (Eleusine scindica) is also common and is a good fodder grass.

Dubh (Cynodon Dactylon) is very common in the firmer soils of the district, and is especially abundant in the hard clay of the Sotar, [illegible]

[illegible]

in the sandy parts of the district.

Kaundra, dudhan and *chaupara* are three grasses or weeds which spring up in great abundance upon the first fall of rain and are largely used as green fodder for cattle. *Baru* (Andropogon Sorghum var. halepensis *), and *takria* are two other common grasses which supply fodder. *Ghamar*

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* See footnote on page 15.

OXEN.	Cattle of Hariana
HISSAR DISTRICT	

(Panicum antidotale) is a grass with a long thin stalk very common near the *canal* It is only grazed when young. The *keo* grass (Sporobolus orientalis) is found on sandhills and resembles *palenji*: it is good for grazing.

Du [illegible] poor soil. [illegible] (Cenc [illegible] and *motya* [illegible] up after the first rains.

According to Colonel Grey the assets of the Hissar district consist largely [illegible] will diminish as the cultivation of [illegible] grazing tract is in the Nali circle; it [illegible] chhadas who prefer cattle-breeding to cultivation. In the Anhdari and other Bagar tracts the people would not be able to maintain themselves and pay the revenue if it were not for their cattle.

The following remarks regarding waste are interesting:—

[illegible] 863, a [illegible] nt to [illegible] there [illegible] But in the present settlement only so much of the waste was unassessed as [illegible]

one-seventh of the whole: but cultivation has increased and there are few large blocks of waste, so that while landlords try to collect the same grazing dues as before, there is much opposition from the tenants and in some places the dues have been reduced, and in others grazing is now free

The rates recommended in the Preliminary Report were half an anna [illegible] grazing tracts and also the largest profits

Droves of cattle are brought from long distances to the Nali circle where between ½ and a ¾ is still waste and dues are paid which would justify a revenue of 2 annas per acre Resident tenants pay one rupee per buffalo, 8 annas per cow or young buffalo, 4 annas for a calf, and half these rates when the waste is small Plough bullocks are always exempted. In some villages a charge is also made for the right to cut *pala* bushes which in a fair season produce 60 seers of fodder per acre valued at 5 annas.

The Nali rate [illegible] tion of the profits [illegible] waste still remain. [illegible] only to villages which have extended their cultivation and rely mainly upon it, but that where the whole or a large proportion of a village has been devoted to pasture the assessment should approach actual half assets. In the Barwala Nali, where waste is extensive, the assessment is

somewhat in excess of the [illegible] full assessment of waste—

	Waste	Percentage
Bhiwani	[illegible]	[illegible]
Hansi	[illegible]	[illegible]
Hissar	[illegible]	[illegible]
Fatehabad	[illegible]	[illegible]

The waste in Bhiwani is chiefly in the Bagar [illegible]. The waste in Hansi is small as compared with other tahsils [illegible] there are several villages which have kept land waste for grazing [illegible]. An area of 7,005 or [illegible] of the whole waste is in [illegible]. In Hissar there is only one prominent village. [illegible] of Fatehabad tahsil is still waste. In the Nali the waste is [illegible] progress in the Nali with regard to cultivation and cattle has been great since 1863.

	Cattle	
	[illegible]	[illegible]
Chal Farawl Nali	[illegible]	[illegible]
Setar Nali	[illegible]	[illegible]
Tohanas Bar Nali	[illegible]	[illegible]
Setar Nali	[illegible]	[illegible]

The Amrain Bagar is a sea of sand [illegible]. But for the cattle the people here would not be able to maintain themselves and pay the revenue. The principal crops are *bajra*, *moth*, *mung* and also [illegible] *guar*, which is used as fodder for cattle, and large profits are made [illegible] breeding and hiring out camels for transport.

Cattle-breeding.—As in Rohtak so in the lower parts of the Hissar district and especially in the Hariana tract cattle-breeding is [illegible] being steadily pushed out by the extension of cultivation. The people in many parts of the southern districts are now becoming more dealers than breeders, buying bullocks largely in March at the fair for agricultural purposes and selling them off as soon as they are no longer required. This is especially the case in parts of the Hissar district near the Sutlej, and I visited several villages where it was the custom. I have mentioned on many occasions that the reason for this custom is that it is cheaper to buy and sell than to breed and rear, and when such a custom prevails [illegible]

[illegible] district differs but little [illegible] ms, however, to be more [illegible] st to drive great numbers [illegible] nsive and good grazing [illegible]

Cattle fairs.—There is a consid[illegible] district which will always act as a heal[illegible] tend more to keep it alive than anyt[illegible] Bhiwani as well as those of Sirsa and [illegible] ing Ryasat of Jhind are well attended [illegible] the people have little difficulty in [illegible] They find a ready market for calves o[illegible] large and small.

At these fairs the great majority of the animals sold are bullocks at the spring fair, and the greater proportion is young stock at the autumn fairs. This suits the people very well for the rearing of cattle in an arid tract like this, subject, as it is, to periodical scarceness of the fodder supply, the rearing of animals is always a precarious undertaking, and this is naturally more so since cultivation has extended and rearing is accompanied

OXEN	Cattle of Harriana

HISSAR DISTRICT.

with more expenditure and risk than formerly, so that it pays better to get rid of the stock bred, at an early stage of their existence The young stock goes to the North-Western Provinces, chiefly to those tracts where there is ... nd the average prices ... season If there be ... great and the prices ... every prospect of a ... for a longer time in ... increase in size and ... Provinces, the de- ... in the success of the ... especially prevalent there the demand for adult stock is much greater to replace the losses which have occurred at the fairs in Phagun and Chait (February and March), there is a greater local demand than at those in Bhadon and ... the former ... tated, many ... lition to the ... brought from ... and sold. The Harriana bred cattle ... Provinces and Panjab districts (see Jehazgarh fair)

It is estimated that about 15,000 animals change hands at each fair at Hissar representing an exchange of about four lakhs of rupees, of which about five lakhs annually come into the district The following statistics show the number of sales and average prices realized —

Fair	Sold	Value	Average
1890		R	
Spring	17 372	3,79,584	21 3
Autumn . .	14,935	4,41,728	29 5
1891			
Spring .	16,812	4 46 784	26 5
Autumn	17,181	4 27 530	24 8

The following are the statistics in connection with the fair —

HISSAR SPRING CATTLE FAIR, 1895.

Statement showing the total number of animals sold, amount changed hands and amount realised from fees at Hissar Spring Cattle Fair, 1895

Serial No	Class	Number present	Number sold	Amount changed hands	Amount realized from fees	Average price of animals sold	Total amount awarded in prizes by Government	Total amount awarded by District Board
				R a p	R a p	R a p	R a p	R a p
1	Cattle	21 850	16 545	4 19 166 0 0	6 549 7 6	25 5 4	—	63 0 0

and Sirsa. (*H. T Pease*) ,OXEN.

HISSAR DISTRICT.

HISSAR AUTUMN CATTLE FAIR, 1895.

Statement showing the names of the districts from which the cattle sold at the Fair were brought.

Serial No	Name of Districts	Number of cattle sold	Young or adult: Young	Young or adult: Adult	REMARKS. Breeds
1	Hissar	11,412	507	10,905	Harriana.
2	Bikanir	3,387	263	3,124	Bikanir.
3	Lahore	1,008	210	798	Manja.
4	Jhind	572	9	563	Bagar
5	Jodhpur	504	11	493	Nagori
6	Jeypur	423	13	410	Marwari
7	Patiala	380	15	365	Malwa and Jangal.
8	Rohtak	259	15	244	Harriana
	TOTAL	17,945	1,043	16,902	

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken

Serial No.	Name of Districts.	NUMBER OF CATTLE PURCHASED: Adult	Young	Total	Class.	By dealers or breeders	REMARKS.
1	Meerut	1,359	166	1,525	Harriana		
2	Muzaffarnagar	1,114	113	1,227	Ditto.		
3	Saharanpur	1,340	105	1,445	Ditto		
4	Aligarh	1,112	19	1,131	Bikanir and Bagar		
5	Bulandshahr	1,193	68	1,261	Same		
6	Delhi	785	35	820	Harriana.		
7	Bijnour	706		706	Small		
8	Kurnal	653	87	740	Harriana		
9	Umballa	886	24	910	Harriana small		
10	Jullandhur	564		564	Harriana		
11	Patiala	522	15	537	Ditto		
12	Ludhiana	588	18	606	Ditto	Both.	
13	Firozepur	482	23	505	Ditto.		
14	Gurdaspur	499	127	626	Bagar		
15	Gurmukhtesar	296		296	Harriana		
16	Faridkot	911		911	Ditto		
17	Jhind	402	39	441	Ditto.		
18	Hoshiarpur	461	19	480	Bagar		
19	Nabha	486	32	518	Harriana		
20	Amritsar	385	13	398	Jangal		
21	Rohtak	789	21	810	Harriana		
22	Bikanir	169	6	175	Ditto		
23	Hissar	646	65	711	Nagori and Harriana		
24	Bareilly	554	48	602	Bagar.		
	TOTAL	16,902	1,043	17,945			

OXEN	Cattle of Harnana

HISSAR DISTRICT

w th more expenditure and risk than formerly so that it pays better to get rid of the stock bred at an early stage of their existence. The young stock goes to the North Western Provinces, ch efly to those tracts where there is re and the average prices the season If there be be great and the prices be every prospect of a good fodder season people hang on to their stock for a longer time in order to real se the enhanced price which comes with increase in size and age If there be a bad season in the North Western Provinces the demand from that quarter which is an important factor in the success of the fairs is reduced When cattle plagues have been especially prevalent there the demand for adult stock is much greater to replace the losses which have occurred at the fairs in Phagun and Chait (February and March) there is a greater local demand than at those in Bhadon and

Jehazgarh fair)

It is est mated t Hissar representing about five lakhs and show the number of

Fa r	Sold	Value	Average
1890		R	
Spr ng	17 372	3 79 584	21 3
Autumn	14 935	4,41 728	29 5
1891			
Spring	16 812	4 46 784	26 5
Autumn	17 181	4 27 580	24 8

The following are the stat st cs in connection with the fair —

HISSAR SPRING CATTLE FAIR, 1895

Statement sl owi ig the total nun ber of animals sold amount cl anged l ands ard amot nt realised from fees at Hissar Spring Cattle Fair, 1895

Serial No	Class	Number present	Number sold	Amount changed hands	Amount real zed from fees	Average pr ce of an mals sold	Total amount awarded in pr zes by Gove nment	Total amount awarded by D st ct Boa d
				R a p	R a p	R a p	R a p	R a p
1	Cattle	21 850	16 545	4 19 166 0 0	6 549 7 6	25 5 4	...	63 0 0

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and Sirsa	(*H. T. Pease*)	OXEN

HISSAR DISTRICT

Hansi Tahsil.

Hansi Tahsil.—The cattle of Hansi offer no differences from those seen in the northern part of the Rohtak district. They are perhaps a little bigger, coarser and more uniform in size, and the herds thus present less irregularity. The largest and heaviest animals in the Harriana tract are bred in this tahsil, many animals of over 60 inches at the shoulder being met with The conditions under which they are kept do not differ markedly from those already mentioned, so that it is unnecessary to go over the whole ground again I reproduce here Major Marrett's description as applied to the cattle of Hissar and Hansi, from which it will be seen that the differences are not marked, if there be any. "The colour of Harriana bulls and bullocks is slate (grey), lighter on the ribs, and darker on the neck, shoulder, and flanks; pure white is sometimes met with The height of the bulls measured behind the hump is from 56 to 64 inches, back wide and straight from behind the hump to the setting on of the tail. The tail is fine and of moderate length, terminating in a tuft of black hair The barrel is good, the animals being well ribbed up Tail fairly well put on, but as a rule there is a tendency to droop at the quarters The thighs are well let down, and the legs well shaped with good bone measurement, which is generally 15 to 21 inches round the elbow and between 7 and 9 inches round the cannon bones. The dewlap in the bull is fairly well developed, extending from the chin to the sternum. The chest is round and deep; the girth measurement just behind the hump ranges from 60 to 72 inches. The head is coarse. The ears are of moderate size and drooping (more so than in the Rohtak district and longer). Horns of moderate thickness and from 12 to 16 inches in length The feet are usually black and well shaped The bulls are generally free from vice

Cows.—The description of the oxen applies generally to the cows, but they are of course lighter in build They have their first calf at between three or four years old, and as a rule make good mothers. They give from 8 to 12 seers of milk.

T[illegible]k.

[illegible] bullocks fr[illegible] ensus of the [illegible] trust to the [illegible] the tahsil

I regret that I am unable to give any records of disease in the Hansi tahsil, but the veterinary assistant is entirely ignorant regarding cattle disease and can neither read nor write so no records were forthcoming. I saw only foot and mouth disease The accompanying form gives the comparative numbers of cattle in the tract and area of land cultivated and uncultivated

Bhiwani Tahsil

Bhiwani.—The cattle seen in the Bhiwani tahsil as far as Tosham are of the ordinary Harriana breed The tahsil beyond Bhiwani and Tosham is comprised in the tract known as the Bagar The soil is sandy. Here cattle give way to camels for agricultural work, and consequently are of secondary consideration for draught purposes The cattle raised on this tract are far smaller than Harriana cattle are and come under the heading of "Bagar" cattle The people consequently keep cows for breeding and milking, and derive large profits from the sale of their young stock, and are bred for sale. The production is greatly in excess of requirements, the excess being sold off to Banjaras who usually travel round the villages purchasing They come from the Jamnapar and buy for the most part young stock The poorer people sell off their stock early at about a year, but those who are able, keep them until they are 2½ to 3 years old. There is a considerable amount of waste land, and given

Statement showing total number of Villages and Cattle in each Tahsil, area in acres (cultivated and non-cultivated) in the District of Hissar

Tahsil	Number of villages	Area in acres: Cultivated in 1890-91	Cultivated in 1892-93	Cultivated in 1893-94	Non-cultivated in 1890-91	Non-cultivated in 1892-93	Non-cultivated in 1893-94	Total in 1890-91	Total in 1892-93	Total in 1893-94	Number of Cattle: Number of Bulls	Number of Cows in 1890-91	Cows 1892-93	Cows 1893-94	Number of Bullocks in 1890-91	Bullocks 1892-93	Bullocks 1893-94	Number of Calves in 1890-91	Calves 1892-93	Calves 1893-94
Bhiwani	133	351 130	413 339	416 245	95,371	84 144	63 465	479 701	479 703	479 710		a93 056	33 376	32 828		17 423	17 836		b32 734	b33,888
Hansi	135	413,279	424,359	427 181	97 978	86 898	84 080	511 255	511 257	511 257		125 059	41 276	41 490		32 894	32 848		41 270	47 635
Hissar	158	379 281	394 471	396 676	138 891	124,076	121 871	518 173	518 547	518 547		80 035	31 108	31 031		19 923	20 028		25 217	17 433
Fattehabad	175	551 093	581 105	584 221	92 477	173 446	170 322	754 570	754 551	754 543		137 83	44 142	45 201		37 568	37 940		37 345	39 556
Sirsa	335	1891-92 801 191	823 779	820 197	1891-92 255 631	233 0 0	236 482	1891 92 1 056 823	1 056,79	1 056 679		1891 92 83 706	30 178	30 933		29 134	28 831		27 495	13,576
Total	1 003	...	2,639,273	2 644,536		681 590	676 210		3,320 853	3,320 736			180 080	181,483		137 342	137 483		164 061	145 089

a Includes Bullocks and Calves also.
b Includes Buffalo Calves a so.

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and Sirsa (*H T Pease*)

OXEN

HISSAR DISTRICT

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Palwal	133	384 130	415,559	416 245	95 571	64 144	63 465	479 701	479 703	479 710		a 93,056	33 376	32 828						
Hansi	159	413,279	424 359	427 157	97 976	86 898	84 080	511 255	511 257	511 257		125 059	41 276	41 490		17 423	17 836		b 31 734	b 33,688
Hissar	139	379 281	394 471	396 676	138 892	124 076	121 871	518 173	518 547	518 547		89 035	31 108	31 031		32 894	32 848		41 270	41,636
Fatehabad	175	661 093	581 105	584 231	93 477	173 446	170 312	754 570	754 551	754 543		137 831	44 141	45 201		19 913	20 028		25 217	17 433
Sirsa	315	1891-92 801 191	823 779	820 197	1891-92 255 632	233 015	236 482	1891-92 1 056,823	1 056,794	1 056 679		1891-92 83,706	30 178	30 933		37 568	37 940		37 345	39 556
																29 134	28 831		27 495	12,576
Total	1,009	...	2,639,273	2,644,53		681 580	676 210	...	3,320 853	3,320 730			180 080	181 483		137 342	137 483		164 061	145,089

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O. 551—94.

and Sirsa (*H. T. Pease*) **OXEN.**

HISSAR DISTRICT.
Bhiwani Tahsil.

BHIWANI AUTUMN CATTLE FAIR, 1895.

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

Serial No	Name of District.	Number of cattle purchased: Adult.	Young.	Total.	Class.	By dealers or breeders.	Remarks.
1	Meerut	Both					The dealers of Muzaffarnagar, Bulandshahr, Meerut, and Delhi districts bought the greater number of cattle.
2	Muzaffarnagar	Do.					
3	Bulandshahr	Do.					
4	Ferozepur	Adult					
5	Delhi	Do					
6	Rohtak	Do.					
7	Gurgaon	Do.					
8	Umballa	Do.				By dealers 10,000, By breeders 288.	
		7,318	2,970	10,288	All kinds		
9	Patiala	Adult					
10	Imlota	Do.					
11	Budaon		Young				
12	Gwalior		Do.				
13	Dujana	Both					
14	Jullundhar	Adult					
15	Aligarh		Young				
16	Muthra		Do.				
17	Saharanpur	Both					
18	Ludhiana	Adult					

OXEN.

Cattle of Harriana

HISSAR DISTRICT
Bhiwani Tahsil

good rain, a fair amount of grazing in such villages as Kairu, Sivana, Shandowa, etc Good cattle are found *in Tusham*, Kairu, Bapara, Bamla, Devsar, Dinod, and Chang The people store fodder in *cons derable quantity*, but in times of scarcity when this is consumed drive off *their* cattle into Bikanir The income from cultivation here *is not great* and *the people look to their cattle to help to pay the revenue* and to maintain them They do not require the Hissar bulls, they prefer their own There is only one Hissar bull in the Tahsil *The general management*, etc of cattle is as in Rohtak and Hansi There is some difference in the names given to cattle—a bull calf 1½ years old is "*Khurch*" at 2½ years it is named "Bahra" or "Dogya," a cow is named Tandi and a bullock Tanda

The people are careless as to the provision of good bulls in this tahsil, and they do not appear to give much attention to the *improvement* of their stock, as will be seen from the measurement of the bulls given.

Prices —Ordinary bullocks fetch R40 to R50 small R20 to R30, ordinary cow R20 to R25 a good cow R35 to R40, bull calf, 2 years R20 to R25 · measurements given

The accompanying statement shows the distribution of the cattle Cattle disease is not common

Cattle Fair

A large cattle fair is now held at Bhiwani in the autumn It has only been started for a few years but is making wonderful progress The class of cattle met with here is about the same as that seen in Hissar Purchasers attend in great numbers The following are the available figures connected with the fair —

Bhiwani Autumn Cattle Fair, 1895

Statement showing the names of the districts from which the cattle sold at the Fair were brought

Serial No	Name of Districts	Number of cattle sold	Young or adult	Remarks.
				Breeds.
1	Hissar . . .			Harriana
2	Rohtak . . .			Ditto
3	Jhind . .		2 970	Young Bagar.
4	Loharu . . .	10 288	7 318	Adults do
5	Jeypur . . .			Marwari
6	Ulwar . .			Mewati
7	Bikanir .			Bikanir

HISSAR DISTRICT.
Bhiwani Tahsil.

BHIWANI AUTUMN CATTLE FAIR, 1895.

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

Serial No	Name of District	Number of cattle purchased: Adult.	Young	Total	Class.	By dealers or breeders	Remarks.
1	Meerut	Both					The dealers of Muzaffarnagar, Bulandshahr Meerut and Delhi districts bought the greater number of cattle
2	Muzaffarnagar	Do					
3	Bulandshahr	Do.					
4	Ferozepur	Adult					
5	Delhi	Do.					
6	Rohtak	Do					
7	Gurgaon	Do.					
8	Umballa	Do					
		7,318	2,970	10,288	All kinds	By dealers 10,000, By breeders 288.	
9	Patiala	Adult					
10	[illegible]	Do					
11	[illegible]		Young				
12	[illegible]		Do				
13	Dujana	Both					
14	Jullundhar	Adult					
15	Aligarh		Young				
16	Muttra		Do.				
17	Saharanpur	Both					
18	Ludhiana	Adult					

OXEN.	Cattle of Harriana

HISSAR DISTRICT, Bhiwani Tahsil

good rain, a fair amount of grazing in such villages as Kairu, Sivana, Shandowa, etc Good cattle are found in Tusham, Kairu, Bapara, Bamla, Devsar, Dinod, and Chang The people store fodder in considerable quantity, but in times of scarcity when this is consumed drive off their cattle into Bikanir. The income from cultivation here is not great and *the people look to their cattle to help to pay the revenue* and to maintain them They do not require the Hissar bulls; they prefer their own There is only one Hissar bull in the Tahsil The general management, etc, of cattle is as in Rohtak and Hansi There is some difference in the names given to cattle—a bull calf 1½ years old is "Khurch," at 2½ years it is named "Bahra" or "Dogya," a cow is named Tandi and a bullock Tanda

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Statement showing the names of the districts from which the cattle sold at the Fair were brought.

Serial No.	Name of Districts	Number of cattle sold	Young or adult	REMARKS.
				Breeds.
1	Hissar . . .			Harriana.
2	Rohtak . . .			Ditto
3	Jhind . . .		2,970	Young Bagar.
4	Loharu . . .	10,258	7,318	Adults do.
5	Jeypur . . .			Marwari
6	Ulwar . . .			Mewati.
7	Bikanir . .			Bikanir.

BHIWANI AUTUMN CATTLE FAIR, 1895.

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		7,318	2,970	10,288	All kinds		
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13	Dujana	Both					
14	Jullundhar	Adult					
15	Aligarh		Young				
16	Muthra		Do.				
17	Saharanpur	Both					
18	Ludhiana	Adult					

OXEN.	Cattle of Harriana
HISSAR DISTRICT. Bhiwani	

Bhiwani Autumn Cattle Fair, 1895.

Statement showing the number and prices of cattle at the Cattle Fair

Bullocks	Cows.	Buffaloes, female.	Buffaloes, male.	Camels	Goats	Others.	Total	Average prices of cattle: 1st quality, bullocks	Average prices of cattle: Ordinary plough bullocks	Average prices of cattle: Young Stock: Two years old	Average prices of cattle: Young Stock: Three years old	Average prices of cattle: Cows, @ per seer	Average prices of cattle: Buffaloes: Cows	Average prices of cattle: Buffaloes: Males.
								R	R	R	R	R	R	R
616,517	21,480	32,405	1,665	7,[illegible]48	45	1,184	680,644	175	50	14	30	7	26	3

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Measurements, etc., of Bhiwani Cattle

Sex.	Age	Height at shoulder	Height at croup	Height at elbow.	Length	Length of horn.	Length of ear	Length of face	Breadth of forehead	Girth at chest.	Girth at abdomen.	Girth of forearm	Girth of shank	Length of neck.	Length of shank.	Colour of skin.	Colour of hair.	Remarks.
1 Bullock	5 years	58	59	27	33	7	10	16	7	79	81	12	7	20	7	White	Grey	Majholi bullock, Bhiwani.
2 "	4 "	56	57	28	33	7	10	17	8	72	79	12	7½	21	10	"	"	Ditto ditto
3 "	5 "	52	53	29	32	7	11	19	9	89	102	13	9	22	10	Black	Black	Ordinary plough bullock, Bhiwani
4 "	4 "	51	52	30	31	7	10	19	9	86	95	13	9	21	10	White	Grey	Ditto ditto.
5 "	5 "	52	53	29	32	7	11	19	9	91	94	13	9	22	10	Black	"	Ditto ditto.
1 Bull	5 years	58	59	35	38	6	11	19	9	92	100	15	9	23	11	Black	Black	Bhiwani.
2 "	5 "	56	56	31	34	7	11	28	9	87	100	15	10	21	11	"	Grey	Ditto
3 "	6 "	51	52	30	34	8	11	17	9	83	97	13	8	20	10	"	"	Ditto.
4 "	6 "	52	53	31	34	11	10	18	9	81	95	12	8	21	11	"	"	Bapora.
5 "	5 "	50	51	30	32	12	11	17	9	85	94	11	8½	20	11	"	"	Tosham.
6 "	5 "	50	51	29	32	12	11	17	9	85	94	11	8½	20	11	"	"	Bhiwani.
1 Cow	5 years	44	43½	22	32	6	6	15	6	65	76	11	6	20	8½	Black	Grey	Ordinary Tosham.
2 "	5 "	43	42½	22	30	6	6	14	6	64	75	11	6	20	8	"	White	Ditto
3 "	4 "	42	41½	21	29½	6	6	13	6	64	73	11	6	19	7	"	Grey	Ditto Bhiwani
4 "	6 "	58	57	36	43	11	10	18	8	74	89	12	7	21	12	White	White	Superior kind, Tosham.
5 "	5 "	52	50	35	43	11	10	16	8	73	86	12	7	20	12	Black	"	Ditto, Bhiwani.
6 "	6 "	48	47	32	38	11	10	15	8	70	85	12	7	19	12	"	"	Ditto, ditto.
1 Cow	6 years	48	47½	27	30½	7	10	15½	6	58	84	11½	6	16	9	White	Black	Common, Tosham.
2 "	6 "	55½	54	28	33	11	10	19	6	65	66	11	7	15	8	"	White	Ditto ditto.

OXEN.	Cattle of Harriana

HISSAR DISTRICT.

Hissar.—The cattle in many parts of Hissar offer no differences from those already described Towards Fatehabad they grow smaller and inferior Those towards the south and farthest removed from the ... influence of the cattle ... ling villages possess ... to be more dealers ... stock to rear, very ... remarkable ... ent bull, for ... part. The people seem very much discontented about their cattle, complaining that there is absolutely no grazing; they say "*agar ek taraf janwar munh marta nahrwala pakarta,*" "*aur agar dusri taraf munh marta bir wala pakarta*" I saw one Gugrat Harriana bull at Babalpur, a good one, but the people deal and ... effect is noticeable. They like the ... the tahsil were in very ... consequent lack of fodde ... famine prices There is little grazing ... it cattle farm, and the animals seen there were almost poorer than the village cattle It is a bad time to ... as the majority have been ... grazing ... ssar Cattle Farm on Saturday, the ... tricts ... kindly ... of cros ... Harriar ... breed ... should ... than 5 ... sheath as close as possible, and hard black feet compact and active, pure bred Harriana bulls well selected are very suitable The stock seen was all young and in rather poor condition, so did not appear to the best advantage.

SIRSA TAHSIL.

Physical characters.—As they are occasionally referred to The following divisions of the belts forming the district made with reference to physical characteristics are given —

(1) The Bagar, the sandy tract south of the Ghaggar valley, characterized by the lightness of the soil, and the prevalence of shifting sand hills It is considered by the people a part of the great Bagar tract which includes a part of the south-west of the Hissar district and almost the whole of the Bikanir territory

(2) The Nali or Ghaggar valley, including the Sotar valley, with its hard, alluvial clay soil and the present valley of the Ghaggar with the villages enclosed between the two valleys and the neighbouring high land belonging to the Ghaggar villages or lying between them and the boundary of the district. These high lands are exactly similar on the one side of the sandy soil of the Bagar, and on the other side to the loam of the Rohi

(3) The *Rohi* or great dry tract, stretching from the Ghaggar valley to the Danda or old bank of the Satlej, and known as the Rohi or Jangal

(4) The Utar or upper belt between the Danda and the present Satlej valley, a tract of light sandy soil with an admixture of river sand now beyond the reach of the Satlej floods

(5) The Hitar or lower belt of alluvial soil subject to inundation

At last settlement the area of land still uncultivated was returned as 13,21,618 acres or 66 per cent of the total area, and now according to the measurement of the present settlement the uncultivated area is only 8,56,622 acres or 45 per cent of the area The culturable area not yet brought under the plough is as follows —

	Total.	Uncultivated total area
Bagar 38,302 or 22 %	48,202	1,73,809
Nali 1,31,661 „ 39 %	1,55,876	5,41,689
Rohi 5,33,095 „ 43 %	5,80,552	12,31,900
Utar 58,716 „ 51 %	61,850	1,15,668
Hitar 23,191 „ 38 %	35,125	60,372

Practically, the whole of this area, say 8 lakhs of acres, is available for cultivation and little inferior in productive capacity to much of the land already cultivated Meanwhile it annually produces abundance of grasses of all kinds in the rains and affords food to great numbers of cattle

Grasses.—Of all the natural products of the district, the most important are the grasses which formerly covered the whole country and still abound in good seasons on the land which has not yet been brought under the plough In the dry tract perhaps the best grass is the *dhaman* (Pennisetum cenchroides) a tall grass with a succulent stem, much valued as food for cattle, and often preserved as hay It is common in the pasture grounds of Bikanir, *and seems to have been formerly common in this district, but it was one of the first grasses to give way before the*

OXEN.

HISSAR DISTRICT.
Sirsa Tahsil

Cattle of Harriana

plough, as it grew on the best lands which were first brought under culti- ... monest grasses is the ... r grass readily eaten ... *bhobriya* Another ... he Punjabis *khoi* or *khavi* and by the Bagris *bur* (Andropogon laniger), also eaten by cattle; its red colour when ripe gives a tinge to the general landscape where it abounds. The *sain* or *sewan* is a tall coarse grass growing in high tufts, with many stalks on one thick root stem and several long narrow ears on each stalk. It is eaten by cattle even when dry. *Garhanm* is a very tall grass with long thin stalks growing from a knotty root stem, not often found growing by itself, but generally round a *kair* bush; cattle eat it when dry, but if they consume it when it is green, it is apt to cause tympanites. *Duchab*, a low grass which remains all the year round, and is eaten by cattle, has long spreading roots which cover the ground in all directions and are difficult to eradicate Among grasses characteristic of the hard soil of the Ghaggar valley are the *khabbal* or *dub* (Cynodon Dactylon), a low jointed grass well known as an excellent fodder. the *dila* (Cyperus tuberosos), a coarse ...

ber ... for ... De ... was a scarcity of fodder ... old in the Sirsa bazar ... *lly in the* sand ... r acre is gath ... his land rever ... grows in cultiv ... have spread largely since the waste was ... lly abundant in the light soil of ... enous tree of the dry tract is the ... Its pods (*Sangri*) are used as fodder for cattle.

When the rains fail the cultivator has nothing to do at home ... takes his wife and childr ... where, at the time of the ... work and live in luxury, ... many such families cross ...

The average amount ... produced by the cultivated land may be estimated to be as follows —

Average produce in thousands of maunds.

	Juar.	Bajra.	Moth.	Rice.	Pala	Wheat	Barley	TOTAL.
Bagar . .	12	184	4	...	50	...	6	256
Nali . .	70	233	10	40	20	59	60	492
Rohi . .	420	630	90	...	50	20	775	1,985
Utar . .	20	69	4	...	5	3	28	129
Hitar . .	33	4	...	...	...	66	12	115
TOTAL .	555	1,120	108	40	125	148	881	2,977

and Sirsa. (*H T. Pease.*) **OXEN.**

HISSAR DISTRICT
Sirsa Tahsil.

Cattle —In former times the wealth of the inhabitants consisted chiefly in their large herds of cattle *which they drove about* from place to place *for* grass and water, but as *cultivation spread* and the produce of the cultivated land increased in value, they became less dependent on the produce of their herds and accumulated other forms of capital There seem to be some signs that the rapid change from the pastoral to the agricultural mode of life which this district has witnessed, and the breaking up of the prairie, may have caused a diminution in the numbers, and perhaps a deterioration in the quality of the cattle of the tract, but their food supply must be *less precarious* now than it was *formerly* when they were entirely dependent on the grass produced annually during the rainy season, which was rarely cut and stored, and they must have died in immense numbers during seasons of drought Yet, even now, notwithstanding the care with which grass and straw are preserved, and the high prices which they sometimes command, a serious drought deprives the cattle of their usual supply of food, and the stock soon becoming *exhausted vast numbers of them die of simple starvation especially*, when in an emaciated condition, they are exposed to the cold following rain Mr Oliver reported in 1863, 1864 and 1865 that the cattle were fast diminishing in numbers and deteriorating in quality, a great number had died of murrain and starvation, and the herds driven towards Kurnal in search of pasture had returned diminished by two thirds of their number, and a great many cattle had been sold and taken down country. The breed had *greatly* deteriorated within Mr Oliver's *experience* of 21 years, none of those fine bullocks for which the country was famed were to be met with The deterioration he ascribed to three causes,—

(1) Diminution of good pasture as all the best of the land is brought under the plough, (2) the frequency of murrain, and (3) breeding in, owing to the smaller herds and their more limited range. In 1866—67 the cattle were still suffering from want of pasture, and in 1867 and 1868 it was reported that more than half the cattle in the district had perished within the preceding two years from scarcity of fodder and the severe frost of March 1868, and the survivors were so tottering and emaciated that they could hardly be driven out to graze Cattle in such a condition were ill prepared to meet the drought of 1868-69, and it was *estimated that in that year of 2,02 327 horned cattle 1,48 590 died and* little more than one fourth were left The Bagris turned their cattle loose and the Mussalmans killed and ate theirs, but the Sikhs spared no trouble and expense to obtain fodder for their bullocks So few were left that in the following *March women were to be seen drawing the plough*

In 1874-75 cattle *disease was prevalent and was ascribed to the* drought, of 13 000 cattle affected 7 000 died Again in 1877 rains failed, and 53 532 head of cattle, or nearly half the number in the district were estimated to have died during the year According to the enumeration made in 1879 there were then about 80,000 horned cattle in the district, or only two thirds of the number *estimated in 1875 76, and only two fifths of* the number said to have existed before the famine of 1868 69

In August and September 1880 we made an enumeration of the cattle of all sorts in the district The opportunity was a good one for the abundant and general fall of rain in the end of June and beginning of July had given a plentiful supply of grass and water everywhere and for the time each village had enough for its own cattle so that few herds had either entered or left the district and at the time of the enumeration almost all the cattle were in their own village, as it is usual for all the cattle to be driven inside the village enclosure every evening, all the patwari had to do was to take the village headman with him in the

OXEN.	Cattle of Harnana

HISSAR DISTRICT.
Sirsa Tahsil

morning, shut all the gates of the village but one, count all the cattle that went out to work or graze, and then go from house to house and co nt those remaining I believe that the e- —
comple'e, and that its results approxi
of cattle owned by residents of the
being, however, probably somewhat ... ... than The following statement gives the number of live stock as then enumerated with the number returned in 1875-76 and 1882 83 :—

	Cattle
1875 76	1,18,030
1880	1,77,152
1882-83	1,80,472

It is evident that the previous enumerations were incomplete, and that the effects of the drought of 1877 78 had been exaggerated I am inclined to believe that the losses of previously bad years were also exaggerated, but there can be no doubt that in 1868 69 a very large proportion of the cattle in the district died At all events the number of horned cattle now in the district is nearly up to the two lakhs estimated as existing previous to the drought of that year After August 1880 the rainfall was very scanty, the grass dried un and ... roduced, and in June 1881 grass had all been complete! harvests and the stacks of t been almost entirely consun , ... as hardly to be got at the ordinary price of grain Had rain held off much longer, many thousands of cattle must have died of starvation, but the plentiful rains of 1881 came just in time and very few cattle were actually lost Three of the four following harvests gave a plentiful supply of fodder and there was but little cattle disease, and in 1883 the cattle were perhaps more numerous and in better condition than they had been since 1868

Bullocks and Cows—According to the enumeration of 1880 the number of ordinary cattle in each assessment circle was as follows :—

	Bullocks	Cows	Bull calves	Cow calves
Bagar	1,964	4,439	1,355	2,835
Nali	8,119	7 360	3 553	3 442
Rohi	38,383	38,240	15,314	15 317
Utar	2,615	2,778	1,176	1,381
Hitar	3 741	3,153	1,097	1,290

and Sirsa. (*H. T. Pease.*) OXEN.

HISSAR DISTRICT. Sirsa Tahsil.

Cattle Fair.—A great cattle fair is held at Sirsa during the months of August, September, and in March, and here a great number of cattle bred in the district are sold for export. The number of bullocks brought to the fair every year with the number sold and the average price have been as follows:—

Years.	Number of Bullocks		Total price.	Average price
	Brought to the Fair.	Sold.		
			R	R
1863 . .	...	11,971	2,07,647	17
1864 . .	...	26,188	4,83,439	18
1865 . .	...	10,060	2,13,174	21
1866 . .	21,953	21,953	5,22,403	24
1867 . .	13,000	10,769	3,06,419	28
1868 . .	15,275	11,775	2,80,758	24
1869 . .	7,600	5,576	1,58,054	28
1870 . .	17,000	13,854	3 90,362	28
1871 . .	7,430	5,426	...	...
1872 . .	6,400	4,885	...	...
1873 . .	12,436	11,051	...	...
1874 . .	23,408	10,787	2,09,807	19
1875 . .	14,222	5,869	1,61,703	28
1876 . .	22,970	8,093	1,95,482	24
1877 . .	27,615	14,031	2,89,474	21
1878 . .	22,095	11,398	2,98,371	26
1879 . .	28,028	22,839	6,29,522	28
1880 . .	23,031	18,541	4,97,027	27
1881 . .	17,491	8,901	2,61,593	30
1882 . .	31,246	19,210	4,41,717	23
Average .	19,071	12,659	3,26,468	25

OXEN.	Cattle of Harriana

HISSAR DISTRICT.
Sirsa Tahsil.

Statement showing number of Bullocks brought, sold, total and average prices, at the Sirsa Cattle Fair from 1884 to 1894.

Years.	No of bullocks brought and sold.		Total prices.	Average price.			REMARKS.
	No brought	No sold		R.	a	p.	
Figures for 1883 . . .	Not	available					
August and September 1884 .	28,339	21,217	5,50,343	25	15	0	
" " 1885 .	30,843	20,527	5,43,717	26	7	10	
March and April 1886 . .	1,930	161	5,019	31	3	9	
September 1886 . . .	43,343	17,458	4,19,313	24	9	6	
March and April 1887 . .	2,000	1,302	16,000	11	6	7	Young stock.
August and September 1887 .	28,482	9,415	2,62,977	28	8	0	
March and April 1888 .	3,931	3,931	47,753	12	2	4	Young stock.
August and September 1888 .	38,069	19 971	5,01,297	29	9	8	
March and April 1889 . .	5,089	2,454	40,001	16	4	10	Young stock.
August and September 1889 .	12,697	6,776	2,09,372	30	0	2	
March and April 1890 .	12,175	3,884	68,373	17	9	8	Young stock.
August and September 1890 .	29,719	18,284	3,93,249	21	9	10	
March and April 1891 .	6,511	6,347	83,539	13	2	7	Young stock.
August and September 1891 .	18,512	13,537	3,88,628	28	11	4	
March and April 1892 .	7,500	5,247	63,608	12	1	9	Young stock.
August and September 1892 .	11,360	7,235	3 44,244	31	0	7	
March and April 1893 . .	700	599	24,205	40	0	0	
August and September 1893 .	22,360	14,482	4,14,692	28	10	1	
March and April 1894 .	7,000	6 619	34 017	20	4	0	Young stock.
August and September 1894	22,368	13,923	3,54,991	25	0	0	

The number of bullocks and cows is about the sam[illegible] Bagar chak, where the Bagri peasants do much of th[illegible] camels and sell their bull-calves, keeping the cow-calves [illegible] with milk. In the Nali and Hitar the fewer number o[illegible] [illegible] great number of milch [illegible] [illegible] than cows are so[illegible] [illegible] not so carefully t[illegible] [illegible] death-rate must be hi[illegible] the number of cows and bullocks in the district probably r[illegible] equal

The numbers of animals which attended up to 1892 were counted as they were brought into the enclosure where the fair was held, and it is possible that some are omitted or counted twice over, but the number of animals sold is trustworthy, for each purchaser has the sale recorded by the clerks employed for the purpose, states the price paid, and gets a certificate of the sale for which he pays a fee of ½ anna per rupee on the price paid. The fair is now held under direct management, and the income from fees was R4,213 in 1881 and R7,114 in 1882. In 1886 the fair was divided into spring and autumn fairs. The spring fair is far smaller than the autumn one as a rule and young stock chiefly brought for sale. The autumn fair is better attended and adult stock forms the greater part of that offered for sale. Purchasers attend in great numbers, and there is a great demand for cattle of all kinds.

OXEN.

HISSAR DISTRICT.
Sirsa Tahsil

Cattle of Harriana

A

SIRSA CATTLE FAIR, 1895.

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

Serial No.	Name of Districts.	Number of cattle purchased.	Class.	By dealers or breeders.	Remarks.
		Spring Cattle Fair, 1895.			
1	Banna	325			Adult cattle.
2	Amballa	351			Do
3	Mainpuri	573			Young stock (calves) and small bullocks
4	Jhind State	30			Adult cattle.
5	Aligarh	737			Young stock.
6	Jaipur State	20			Adult cattle.
7	Hissar	1,676			Both.
8	Shahpur	689			Adult stock.
9	Dera Ismail Khan	637			Do.
10	Etawah	878			Young stock.
11	Agra	254			Do.
12	Patiala State	258			Both.
13	Farrukhabad	151			Young stock.
14	Muzaffarnagar	21			Both.
15	Saharanpur	10			Do.
16	Rohtak	81			Adult.
17	Bulandshahr	60			Both.
18	Gujranwalla	139			Adult.
19	Ferozepur	120			Do.
20	Jallandhar	5			Do.
21	Sialkot	0			Do.
	TOTAL	7,035			

and Sirsa. (*H. T. Pease.*) **OXEN.**

HISSAR DISTRICT.
Sirsa Tahsil.

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

Serial No	Name of Districts.	Number of Cattle purchased.			Class.	By dealers or breeders.	Remarks.
		Adult.	Young.				
		Autumn Cattle Fair, 1895.					
1	Muradabad						
2	Bulandshahr						
3	Aligarh						
4	Kurnal						
5	Meerut						
6	Jullandhar						
7	Ferozepur	8,820	4	8,824	All.	Both.	
8	Rohtak						
9	Hissar						
10	Ludhiana						
11	Amballa						
12	Muzaffargarh						
13	Faridkot						

OXEN.

HISSAR DISTRICT. Sirsa Tahsil

Cattle of Harriana

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2	Amballa	351	...	...	Do.
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4	Jhind State	30	...	...	Adult cattle.
5	Aligarh	737	...	...	Young stock.
6	Jaipur State	20	...	...	Adult cattle.
7	Hissar	1,676	...	...	Both.
8	Shahpur	659	...	..	Adult stock.
9	Dera Ismail Khan	637	...	...	Do.
10	Etawah	878	...	...	Young stock.
11	Agra	254	...	...	Do.
12	Patiala State	258	...	...	Both.
13	Farrukhabad	151	...	...	Young stock.
14	Muzaffarnagar	21	...	...	Both.
15	Saharanpur	10	...	...	Do.
16	Rohtak	81	..	...	Adult.
17	Bulandshahr	60	...	...	Both.
18	Gujranwalla	139	...	...	Adult.
19	Ferozepur	120		...	Do.
20	Jallandhar	5	...	...	Do.
21	Sialkot	0	...	...	Do.
	TOTAL	7,035			

O. 551—94.

and Sirsa. (H. T. Pease)

OXEN.

HISSAR DISTRICT.
Sirsa Tahsil.

Statement showing the districts to which the cattle, including buffaloes purchased at the Fair, were taken.

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		Adult.	Young.				
	Autumn Cattle Fair, 1905.						
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2	Bulandshahr						
3	Aligarh						
4	Kurnal						
5	Meerut						
6	Jullandhar						
7	Ferozepur	8,820	4	8,824	All.	Both.	
8	Rohtak						
9	Hissar						
10	Ludhiana						
11	Amballa						
12	Muzaffargarh						
13	Faridkot						

OXEN.	Cattle of Harriana

HISSAR DISTRICT. Sirsa Tahsil.

The cattle at the spring fair are almost all young animals bred in the neighbourhood, many of them untrained, and they are bought principally by dealers ... to the Upper P... and across the Jumna, ... umn fair are generally ... as attend the Hissar ... and States:—

Year.		Sirsa.	Rohtak and Hissar	Bikanir.	Patiala.	Others.
1876	. .	3,615	4,028	1,080	...	1
1877	. .	5 324	5,909	3,099	417	9
1878	. .	6,096	2,954	1,666	658	253
1879	. .	11,174	8,258	2,212	1,255	294
1880	. .	8,372	7,842	1,194	1,543	198
1881	. .	4,395	2,371	1,215	1,135	74
1882	. .	6,851	5,852	3,414	2,455	1,731
Per cent.	. .	43	34	14	7	2
1895 Spring	.		5,133*	2,239	1,117	288

* Includes Sirsa

The number of cattle brought to the fair and sold and the average price depend chiefly on the nature of the season. The prospect of a drought and a scarcity of fodder in the neighbourhood brings a great number of cattle to the fair, as their owners having difficulty in providing for them are anxious to sell, thus in the ye... cattle brought was great; on the other h... abundant and the prospects of rabi ... anxious to sell and few ... in 1875 and 1881. Again, a drought in the ... that quarter and few cattle are sold as in ... rs came from the North-Western Provinces. The prices of course depend on the relation of supply and demand and vary accordingly, being ordinarily lowest in years of drought, such as 1877 when many at... and highest in years of plenty, such as 1... keep them at home and when many h... support more cattle. The effect of the ... in diminishing the number of cattle in the district may be seen in the rapid rise in price and the fewer number of cattle sold for years afterwards, but now, although the price has not fallen so low, the numbers have recovered. On an average of about 20,000 bullocks brought to the fair, nearly 13,000 have been sold for ¾ lakh of rupees at an average price of R25 per bullock. During the last seven years nearly half the animals sold at the fair have come from the Sirsa tahsil, and almost all of these are sold out of the district; so that on an average the S... the breeders sell at Sirsa fair alone a surplus stock of 6,000 young ... about 1½ lakhs of rupees in ... more than half th... assessment of the district, and ... their realizat... fair amount to 2 lakhs of rupee... statement ... will show the districts to which ... from this figures given relate only to the ... authorit...

HISSAR DISTRICT.
Sirsa Tahsil

thought necessary to collect those for the autumn one The classes of cattle attending are the same as those at Hissar. Sirsa bullocks are

than 2 lakhs of rupees.

Few bull calves are allowed to grow up as bulls The lucky animal selected to succeed his sire as lord of the village herd has an easy time of it. The peasants are careless about the quality of the bull, though they

were bought at the Sirsa fair at an average of R50 The price has now risen very considerably, and animals of the class required cannot as a rule be got for R80 to R100.

Cows.—Few cows are sold out of the district, they are kept for breeding purposes and for milk At the Sirsa fair only about 100 animals are sold annually and their average price there is from R8 to R9, but

The average longevity appears to be about twelve years Cows are milked twice a day, morning and evening; for the first fortnight the calf is allowed to take all the milk, for three months it gets half the milk and then a quarter of it. A Sirsa cow will not allow herself to be milked unless the calf is present and the milker ties the calf to her leg before commencing. An ordinary cow gives about 4 seers of milk a day from which 2 or 3 chittacks of *ghi* can be extracted Milk sells in Sirsa at about 16 seers per rupee; but in the villages it is much cheaper. The cows of the

OXEN.	Cattle of Harriana

HISSAR DISTRICT. Sirsa Tahsil.

The cattle at the spring fair are almost all young animals bred in the neighbourhood, many of them untrained, and they are bought principally

and Jahazgarh fairs and the business done is in the same class of animals, with the exception that Mewati cattle are not brought in The animals sold during the seven years ending 1882 come from the following districts and States:—

Year.	Sirsa.	Rohtak and Hissar	Bikanir.	Patiala.	Others.
1876	3,615	4,028	1,080	..	1
1877	5 324	5,909	3,099	417	9
1878	6,096	2,954	1,666	658	253
1879	11,174	8 258	2,212	1,255	294
1880	8,372	7,842	1,194	1,543	198
1881	4 395	2,371	1,215	1,135	74
1882	6,851	5,852	3,414	2,455	1,731
Per cent	43	34	14	7	2
1895 Spring		5,133*	2,239	1,117	288

* Includes Sirsa

The number of cattle brought to the fair and sold and the average price depend chiefly on the nature of the season. The prospect of a drought and a scarcity of fodder in the neighbourhood brings a great number of cattle to the fair, as their owners having difficulty in providing for them are anxious to sell, thus in the ye

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[illegible] in 1875 and 1881.

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pees at an average price

nearly half the animals

sold at the fair have come from the Sirsa Tahsil, and almost all of these are sold out of the district; so that on an average the Sirsa cattle breeders sell at Sirsa fair alone a surplus stock of 6,000 young bullocks for about 1¼ lakhs of rupees in hard cash, or more than half the total new assessment of the district, and in some years their realizations at this fair amount to 2 lakhs of rupees. The foregoing statement (marked A.) will show the districts to which cattle are taken from this fair The figures given relate only to the spring fair as the authorities have not

HISSAR DISTRICT.
Sirsa Tahsil.

thought necessary to collect those for the autumn one. The classes of cattle attending are the same as those at Hissar. Sirsa bullocks are

than 2 lakhs of rupees.

Few bull-calves are allowed to grow up as bulls. The lucky animal selected to succeed his sire as lord of the village herd has an easy time of it. The peasants are careless about the quality of the bull, though they

nine, and sometimes survives work and droughts to the age of 15. His work is constant but seldom very severe, and he is carefully tended by his master, *especially if a valuable animal and his master is a Sikh.* A young bullock grazing in the prairie is sometimes given eight seers of

be got for R80 to R100.

Cows.—Few cows are sold out of the district; they are kept for breeding purposes and for milk. At the Sirsa fair only about 100 animals are sold annually and their average price there is from R8 to R9, but

twice a day, morning and evening; for the first fortnight the calf is allowed to take all the milk; for three months it gets half the milk and then a quarter of it. *A Sirsa cow will not allow herself* to be milked unless the calf is present, and the milker ties the calf to her leg before commencing.
...rs of milk a day from which 2 or
Milk sells in Sirsa at about 16 seers
is much cheaper. The cows of the

OXEN.	Cattle of Harriana

HISSAR DISTRICT. Sirsa Tahsil.

... re common; and if 10 seers of fodder ... ne chopped straw. ... l in 1880 was as follows:—

	Males.	Females.
Bagar	361	1,076
Nali	2,120	3,621
Rohi	1,819	8,187
Utar	101	517
Hitar	237	1,861

Buffaloes cannot stand heat well and are seldom made to work in this district, but sometimes a buffalo may be seen in a cart or plough, or working at a well, yoked along with a bullock. Male buffaloes are usually sold to dealers from the districts farther north where they are used in cultivation, while buffalo cows are kept for milk and breeding purposes. Thus, three-fourths of the buffaloes in the district are cows, and almost all the buffaloes sold at the Sirsa fair, where sometimes nearly a thousand change hands, are males. The average price of a buffalo male at Sirsa fair is about R12, but sometimes R15 to R20 can be got. Buffalo cows are highly valued for their milk. A buffalo calves when 5 years of age in the eleventh month, usually about July; she ordinarily gives six or seven calves at intervals of two years. The calf is allowed to take all the milk for the first month, then half for three months, and a quarter for three months more. A buffalo gives milk for about a year, usually for ... fifteen mo... once a d... dium, from ... The buffal... to those of the dry uplands. On the Satlej a good buffalo cow, giving 10 seers of milk a day, fetches as much as R100, and the ordinary price may be taken at about R60 or R70 in the Hitar and R40 to R50 in the Rohi. ... as much as an ordinar... ... es are usually twice th... ... when giving milk ar... ... fodder daily; but an ordinary buffalo is driven out with the village herd to graze in the common and gets a little chopped straw at home and perhaps a feed of grain.

Produce and Price of Ghi.—The Sirsa tahsil has for many years produced a large quantity of *ghi* over and above its own requirements for export northward to Ferozepur and eastward towards Delhi. With the improvement of communications and the increase of population, the price of *ghi* has gradually risen, and, as it is valuable in comparison with its bulk, its price has not been subject to such violent fluctuation as that of the heavier food-grains, although it has varied considerably with the number of cattle and the supply of fodder. Like the other produce of the district, *ghi* made its first decided start upward in price after the drought ... steady between R... to ... of cattle died in the ... d R18 till 1864. In that year a great number of cattle died from disease and starvation, and it was probably in consequence of this that in 1865 the price rose to over R20 per maund. The next three years were bad for cattle and the price

OXEN.	Cattle of Harnana

HISSAR DISTRICT.
Sirsa Tahsil

large area in each vil [illegible]
proposals have again [illegible]
ments may be to keep [illegible]
effect in protecting the [illegible]
such years the unculti [illegible]
up to a certain limit not yet nearly reached In Sirsa, cultivation actually *increases* the produce of fodder, and especially of storeable fodder, and thus renders the district better able to support its cattle in years of drought.

The average produce of straw even *in unirrigated fields* may be estimated at 4 maunds per acre, which is much more than the storeable produce of grass on the same land when uncultivated; but even in a year of drought like 1880, when the grass wastes produced almost *nothing*, the cultivated lands were estimated to have grown 2 or 3 maunds of fodder per acre *Pala too*, which is considered one of the best fodders, grows more plentifully on cultivated than on uncultivated land. Considerable efforts are made by the people to store up fodder for their cattle Some crops, such as *jowar*, turnips, and *moth*, are grown chiefly for the fodder they give, and care is taken to gather and store not only these crops, but also the straw of barley, wheat, *jowar*, and *bajra*, stocks of which may be seen about the homesteads of every village

Pala and some of the best grasses are also cut and stored It seems that more care is now taken than formerly to store fodder in these ways and preserve it for seasons of drought, and that the experience of the last two or three scarcities has taught the people to use every available means of storing fodder against such seasons But, as a rule, all that they can do is to store up a quantity *sufficient* to support their cattle during the hot months of the dry weather, when no green food is available and the cattle have to be supported wholly on the stored fodder. This gets exhausted towards the end of June If the rains then fail and no grass springs up, the cattle are left without food and numbers of them die, yet, except perhaps for a short time after one of these recurring scarcities, the district has always more cattle than it requires for agriculture and can afford to export a large number of young bullocks If the peasants of the district breed fewer, the supply of fodder would be large enough to support a larger proportion of them through a drought, and the loss of cattle in a season on scarcity would be smaller; but then their *surplus stock* and *their profits from the* sale of young stock in ordinary season would be less Cattle-breeding in [illegible] ness, and the peasants seem to [illegible]

to take their chance of the rains failing. If the rains come as usual the speculation is a success and the cattle are safe for another year; if they fail, the speculator loses his profits and some portion of his capital; but [illegible] up to him again. It is not improbable [illegible] would be utilized by the pea- [illegible] g against the consequences of [illegible] further and taking his chance of [illegible] is in the circumstances the most [illegible] breeder. The annual [illegible]

less, as they are less dependent on the precarious produce of the [illegible]

and Sirsa. (*H T. Pease*) | OXEN.

HISSAR DISTRICT.
Sirsa Tahsil.

have larger supplies of fodder to supplement it. It is probable that the

Price :—

Good	bullocks	fetch	R125,	ordinary	R50,	lowest	R20
"	cows	"	R 60	"	R40	"	R15
"	buffaloes	"	R120	"	R50	"	R35
Male	"	"	R 30	"	R15	"	R 5

fair profit on them. They are wice yearly at Sirsa, the best " from Shahpur, Dera Ismail ell them in their own districts and also in those of Gurdaspur and Amritsar They sell on the *Udhar* system, taking payment in two instalments called *do kist*, the first payable in January and the second in July.

The second class of purchasers are "Banjaras" chiefly Chauhan Rajputs from the districts of Aligarh, Mainpuri, Agra, Etawah, Etah, and Furruckabad. These take chiefly young stock or small Bikanir bullocks which they sell for work in sugar mills The young stock are disposed of in their own districts as far as Cawnpur They are purchased by cultivators in parts where grazing is available, who rear them by grazing got, and in *usar* lands and . The majority of the small he sugar-growing districts. ad.

OXEN.	Cattle of Harnana
ROHTAK DISTRICT.	

Appendix A.

Statement showing the number of cattle present in each village of the Rohtak District

Jhajjhar Tahsil.

Number	Names of Villages	Number of cows	Number of bulls.	Number of bullocks	Number of calves	Number of buffalo cows	Number of buffalo bulls	Number of ordinary Desi bulls	Remarks
1	Saraula	137	2	130	124	24	2		
2	Chapar	299	2	248	235	70	1		
3	Girdherpur	108	1	80	36	12	1	1	
4	Babpur	121		79	93	15	1		
5	Sohana	337	1	345	358	59	1		
6	Dhakla	358		397	315	82	2		
7	Chandoul	126	1	139	157	30			
8	Kherijath	220	1	223	302	105	3		
9	Mahmudpur majra	31	3	35	30	12			
10	Faizabad	67	2	55	67	18			
11	Ladpur	190	1	295	147	32	2	1	
12	Kokiana	142	1	91	117	31	2		
13	Raepur	79		69	84	26			
14	Dadarpur	237	1	185	152	47			Jungle.
15	Chandpur	63	1	38	41	14	1		
16	Kalranda	139	1	85	105	32			
17	Saloda	223	1	219	184	89	2		
18	Kaheri	112	1	122	112	48	13		Jungle
19	Kolana	121	1	76	82	27	4		Do
20	Koka	82	1	57	74	24	6		Do
21	Asedpur Khera	97	1	73	81	30	5		
22	Ahri	342	2	259	147	45	8		
23	Iserhera								
24	Fatehpuri	106	2	87	105	30	4		
25	Chandpuri								
26	Suraiti	319	2	270	280	75	1		Jungle
27	Sameshpur majra	219		184	242	44			
28	Sarakhpur Wairan								
29	Khoodan	399		390	414	101	1		Jungle.
30	Sikandarpur	91	1	55	117	36	1		
31	Khora	81	1	76	72	16			
32	Kasni	393	2	272	469	51	2		
33	Machrauli	519	3	399	373	99	4		
34	Mangawas	13	1	9	17			1	
35	Khanchrauli	205		115	146	23	1		
36	Kaliwas	175	2	132	265	24	1	2	
37	Bora	42	1	33	64	9			
38	Khoongai	137	1	136	177	95	13		
39	Jaitpur								
40	Chalj	211	2	161	145	45	4		
41	Islamgarh	432	2	237	354	81	1		
42	Berdhana	332	1	336	493	177	5		Jungle
43	Sarauli	305	3	279	356	107	5		

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ROHTAK DISTRICT.

Jhajjhar Tahsil

Statement showing the number of cattle present in each village of the Rohtak District—continued

Number.	Names of Villages	Number of cows	Number of bulls	Number of bullocks	Number of calves	Number of buffalo cows	Number of buffalo bulls	Number of ordinary Desi bulls	Remarks
44	Bidhana	47	1	43	48	16		..	
45	Bajidpur	85	1	36	147	35	7	.	
46	Biharipur	190	2	120	169	37	4	..	
47	Palra	228	1	156	218	19	.	.	
48	Tatarpur		.	.	..	.		..	
49	Talao	417		349	493	61	3		
50	Jondi	196	1	163	155	61	2		
51	Husainganj (urf) Jehazgarh	347	2	258	358	52	5		
52	Chandani	325		212	280	102	5		
53	Dadla	292		201	307	52			
54	Dhaur	246	1	167	309	58	3	1	
55	Checkakwas	20	2	9	19	6			Bir
56	Sarkar Putta Rawaili	134		124	123	37	2		
57	Saikhupur	94	1	60	110	27	1		
58	Fortpura	38	1	31	37	10			
59	Tomspura	94	1	61	67	26	3		
60	Sonarwali								Bir
61	Camelgarh	1			1				
62	Kherkhumar	343	1	356	391	22		–	
63	Kaplana	289	1	225	281	85	2		
64	Khatiwas	230		186	184	32	1	1	
65	Garawar	107	1	113	122	26		1	
66	Godda	231	1	180	173	77	7	—	
67	Gowalisan	237	1	209	293	46	1	—	Jungle
68	Gaderi	127		77	114	12	1	—	
69	Malikshahpur	190	–	147	183	40	2	—	
70	Mohamedpur majra	314		283	456	66	–		
71	Nagli							–	
72	Babra	94		89	74	30	1		
73	Gajrand	99		82	76	33	2		
74	Salana	434		351	406	134	8		Jungle
75	Jehangirpur	433	2	312	483	132	4	–	
76	Soora	154	1	136	170	42	2	—	
77	Doorina	6		4	7	1	–	—	
78	Kalai	168	1	102	163	[illegible]	8	—	
79	Munimpur	169	2	126	168	[illegible]	2	—	
80	Bamnaula	261		175	206	[illegible]	4	—	
81	Pailpa	231	2	152	213	66	1	–	
82	Badhana	117	–	68	104	4	–	—	
83	Sondi	137	–	90	108	[illegible]	1	2	
84	Badli	887	6	945	959	[illegible]	12	—	
85	Daryapur	207	1	157	123	35	3	—	
86	Lagadpur	103	–	35	72	33	3	—	

OXEN.
ROHTAK DISTRICT. Jhajjhar Tahsil

Cattle of Harriana

Statement showing the number of cattle present in each village of the Rohtak District—continued

Number	Names of Villages	Number of cows	Number of bulls	Number of bullocks	Number of calves	Number of buffalo cows	Number of buffalo bulls	Number of ordinary Desi bulls	Remarks
87	Ismaelpur	150	1	109	179	40	2	1	
88	Dewakhana	110	1	79	55	30	2		
89	Lohath	66	1	39	31	5			
90	Badsa	406	1	342	348	109	3		
91	Mundakhera	145	1	189	193	62			
92	Fatehpur	128	1	66	102	28		1	
93	Yakubpur	269	3	379	372	130	9	3	
94	Khal kpur								
95	Katanee	172		155	136	90	10		Jungle
96	Nangla	63	1	73	48	16	1	1	Do
97	Dadree	191	1	139	254	74	2	1	Do
98	Sanjipura								
99	Aurangpur	157	1	111	159	69	3		
100	Zahadpur	123	1	245	219	215	28	1	Jungle
101	Untloda	69		53	56	19	1		
102	Sab li	97		65	73	15			
103	Patasni	110		62	97	28	1		
104	Batha ra	252		157	272	175	6		Jungle
105	Amadalpur	186		117	143	65	2		Do
106	Kherlpatanda	297		241	318	17	31		Do
107	Lahoree	474	5	150	371	345	65		Do
108	Patanda	647	3	579	655	151	7		
109	B rdadri								Bir
110	Okhalchana	248		216	344	103	2		Jungle
111	Salampara Zal m	240		208	273	96	3		Do
112	Salampara Kaisho	276		211	309	95	11		Do
113	Jakhala	116		109	227	15	8		
114	Gooryanl	490	2	170	179	30	10		Jungle
115	Borl vas	40		22	67	12	1		
116	Ahmedpur	114		71	78	10	1		
117	Soorukhpur Patta koshi	94	1	80	77	19			
118	Shad pur	70	1	25	38	22	4		
119	Modhaira	170		86	70	55	16		Jungle
120	Borampur	68		57	66	13			
121	Ratamthal	710	2	294	435	93	18		Jungle
122	Usmanpur	117		115	163	43			
123	Neola	142		115	261	20			
124	Ja lpur	289		114	160	18	1		
125	Jhunda	223		74	91	24	2		
126	Mobarakpur	102	1	78	109	18			
127	Toombahairl	325		149	170	99	3		Jungle
128	Khaparwas	132		121	214	31	3		Do
129	Kot i	991		665	894	158	2		Jungle
130	Bhorthe a	71		51	118	16	1		
131	Zehadp rkoshi	113		83	124	9			

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ROHTAK DISTRICT.

Jhajjhar Tahsil

Statement showing the number of cattle present in each village of the Rohtak District—continued

Number	Names of Villages	Number of cows	Number of bulls	Number of bullocks	Number of calves	Number of buffalo cows	Number of buffalo bulls	Number of ordinary Desi bulls	Remarks
132	Tomna	353		191	249	61			
133	Bola	126		81	198	8			
134	Murchli	175		131	199	36	1		
135	Nathaira	121		116	112	23	1		
136	Bhakli	122		154	262	33	1		
137	Chawah	70		77	87	10			
138	Salawas	588		327	464	96	3		
139	Bajidpur	17		11	11	5	1		
140	Jhamri	277		56	160	1	6		
141	Dhillawas	166		109	163	15	3		
142	Sasrauli	306		187	321	67			Jungle
143	Mahawas	97		40	88	20			
144	Selings	252		180	191	18	4		Jungle
145	Barahar	648		437	596	53	7		Do
146	Sundraethi	272		131	180	24	3		
147	Ruriawas	187		130	129	17	1		
148	Matanhail	676		567	833	192	5		Jungle
149	Mundsa	197		146	143	52	1		
150	Raidhuwas	102	1	87	122	21	5		
151	Dhainia	112		72	35	14			
152	Rankhanda	57		34	47	15			Jungle
153	Bukhtiadpur	200		142	214	46			
154	Babolia	89		47	82	10			
155	Bhindawas	193		150	161	40			
156	Bilochpura	106		123	139	19	2		
157	Hussanpur	152		98	132	49	1		
158	Chadwana	138		115	124	30			
159	Koelpuri	161		118	138	39			
160	Khatiawas	161		152	216	53			
161	Khaparwas	166		99	100	25			
162	Kunjia	144		90	67	35	2		
163	Karanda	114		74	92	16			
164	Kher hoshdar	119		85	115	26			
165	Marante	303		232	278	51	3		
166	Nawada	44		45	63	12	2		
167	Khandrai	109		60	105	27			
168	Silahari	213		144	148	14			Jungle
169	Mundahaira	234		276	279	47	1		Do.
170	Boror	200		136	158	40	1		
171	Kherimadanpur	195	5	58	918	8	10	...	Jungle
172	Madalpur	67		51	45	17		...	
173	Nowgawan	379		197	239	59	14		
174	Ladrani	365	1	242	303	70	3		Jungle
175	Humaunpur	157		102	167	14			
176	Jhanswa	309	1	176	230	40	2	...	

OXEN

Cattle of Harriana

ROHTAK DISTRICT. Jhajjhar Tahsil

Statement showing the number of cattle present in each village of the Rohtak District—continued

Number	Names of Villages	Number of cows	Number of bulls	Number of bullocks	Number of calves	Number of buffalo cows	Number of buffalo bulls	Number of ordinary Desi bulls	Remarks
177	Jhorli	239	1	163	2?8	56	2		
178	Mohanbori	141		88	83	23	1		
179	Dhana	115	1	80	149	13			
180	Dharwas	102		92	89	22			
181	Jemalpur	133	1	80	133	17			
182	Bhoorawas	494		270	242	67	8		
183	Buthaila	253		143	169	27	2		
184	Bhikanpur	1			2				
185	Amanli	189		162	222	31			
186	Dharauli	154	1	102	177	33	2		
187	Maliawas	51	1	32	45	3	1		
188	Gagoda	263	1	111	47	30	7		
189	Shahjehanpur	59		36	73	14	2		
190	Jhajjar	1,281	2	911	1 246	290	7		
	Rohtak								
1	Rohtak	1,212		1 156	1 787	421	5		Jungle
2	Tagamajra								
3	Sarae Ahmed	16		6	18	2			
4	Kotana	.							
5	Goddikheri	237		213	369	115			
6	Bakra	72		88	88	25	1	2	
7	Bagpur	159		184	190	54	2	1	
8	Balaur	555		588	724	131	1	2	
9	Basahan	196		179	179	73		1	
10	Ballab	236		193	223	67	2	1	
11	Bahar	1 074		1 062	160	363	20	3	Jungle
12	Bhootian								
13	Bhaniyapur	95		119	183	50			
14	Parah								
15	Bairi	1 331		1 177	1 667	386	2	30	
16	Paihrawar	171		156	139	52	3	2	Jungle
17	Jelalpur								
18	Chunnee	292		293	452	112	1	1	
19	Dobaldhan	978		1,432	1 591	205	7	8	
20	Dharana	194		170	253	77		2	
21	Ritanli	427		356	391	113	3	1	Jungle
22	Sonarik Khoord	254	-	272	313	6	6	1	Do
23	Sonari Kalan	348		402	456	126	1	1	Do.
24	Sawana	484		377	455	105	2	2	
25	Sondana	480		234	459	147	7	4	
26	S[illegible]	50		65	87	31		1	
27	Kaboo[illegible]pur	2[illegible]3		265	324	10[illegible]	2	1	
28	Harsurtha	330		466	414	242	4	2	

Rohtak Tahsil

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ROHTAK DISTRICT
Rohtak Tahsil.

Statement showing the number of cattle present in each village of the Rohtak District—continued

Number	Names of Villages	Number of cows	Number of bulls	Number of bullocks	Number of calves	Number of buffalo cows	Number of buffalo bulls	Number of ordinary Desi bulls	Remarks
29	Kakrana	171		184	140	44		2	
30	Kaloi	710		936	1 283	533	6	2	
31	Kanauli	101	..	98	206	80		1	
32	Goornauthi	297		302	318	70	1	4	
33	Majra	841		772	945	254	6	3	
34	Meena	292		266	396	103	1	2	Jungle.
35	Matana				.			...	
36	Marad jatun	175		104	219	82	1	1	
37	Masoodpur	59		60	69	20		1	
38	Wazirpur	119		127	167	67	2	2	
39	Doab	144		210	329	106	3	1	
40	Anwal	384		489	494	197	5	2	
41	Baniyani	119		342	316	44	3	1	
42	Basana	170		158	177	74	1	2	
43	Bahalinandpur	192		249	311	91	1	2	
44	Patwapur	149		172	224	76	1	1	
45	Pailana	445		314	372	122	7	3	
46	Taunoorpur	69		42	50	21		1	
47	Sangbahaira	77		81	89	24	1	1	
48	Samepal	156		185	182	88	1	1	
49	Knaur	809		874	1 047	398	14	3	
50	Kaitiora	256		260	334	154	1	2	Jungle
51	Kalanaur	1 313		1 475	1 551	561	12	4	
52	Karak Khoord	259		227	250	86	3		
53	Karak Kalan	995		890	963	249	10	10	
54	Khairi	137		112	202	66	3	1	
55	Kailga	1,027		815	843	273	9	4	
56	Gaddi Ballab	116		107	106	42	2	1	
57	Laheli	287		301	316	138	2		
58	Manjah								
59	Moradpur Tarkna	71		72	136	41	1	2	Jungle
60	Morandirangran	198		237	215	95		1	
61	Nagana	811		909	189	466	7	4	
62	Bahnakbarpur	842		439	800	285	8	5	
63	Mokha	997		1 011	1 354	38[illegible]	4	5	
64	Bahmanwas	89		101	103	7[illegible]	2	1	Jungle
65	Tatoli	685		697	703	425	22	2	
66	Jassiya	335		447	652	302	4	10	
67	Chamoree	138		265	289	247	19	1	
68	Joindpran	117		127	140	69	2	1	
69	Sanghi	647		970	1 182	680	19	15	
70	Sahanmajra								
71	Sasrauli	55		52	68	57	3	1	
72	Soondarpur	238		226	318	164	3	1	
73	Singhpura	870		956	1 213	558	13	15	

OXEN.

ROHTAK DISTRICT.
Sampla Tahsil.

Cattle of Harriana

Statement showing the number of cattle present in each village of the Rohtak District—continued.

Number.	Names of Villages.	Number of cows.	Number of bulls.	Number of bullocks.	Number of calves.	Number of buffalo cows.	Number of buffalo bulls.	Number of ordinary Desi bulls.	Remarks.
46	Sulanthi	99	1	76	104	25	2	...	
47	Mehdipar	82	1	94	79	19	3	...	
48	Dabodakalan	94	1	115	122	49	...	...	
49	Daboda Khoord	243	1	261	294	92	2	...	
50	Dalailpur	31	1	44	39	21	...	...	
51	Loda Khoord	152	2	209	218	85	1	...	
52	Lya Majra	168	...	383	364	121	2	...	
53	Sarar Aurangabad	85	2	125	88	39	1	...	
54	Khaidka Musalman	25	1	35	34	17	...	...	
55	Saldah	270	2	236	286	69	...	...	
56	Tandahairi	84	1	123	153	39	1	...	
57	Kasar	110	1	133	194	36	2	...	
58	Sankhoul	133	3	204	238	61	1	...	Jungle.
59	Bamnauli	209	1	272	449	115	2	...	Do.
60	Makundpur	40	1	35	34	12	...	...	
61	Kananda	361	2	404	506	132	5	...	Jungle.
62	Khairpur	54	1	64	98	24	...	...	
63	Ladron	242	1	297	297	136	3	...	Jungle.
64	Kalasee	272	1	346	404	178	2	...	
65	Aroda	404	2	722	677	334	4	...	
66	Barahee	131	2	397	387	184	2	...	
67	Jhakhoda	159	1	210	308	57	1	...	
68	Sodhpur	...	...	...	...	...	...	...	
69	Mandanthe	813	3	1,075	1,032	358	3	...	
70	Rohad	524	1	555	756	157	1	...	
71	Dehkora	137	1	160	160	100	...	...	
72	Lahorihairi	198	1	154	235	63	...	...	
73	Atail	243	2	355	370	172	4	...	
74	Morekheri	174	1	278	269	113	3	...	
75	Khertsadh	213	1	211	319	39	3	...	Jungle.
76	Nayabas	135	...	187	269	95	1	...	
77	Giji	127	1	60	234	86	2	...	
78	Bhanishra Khoord	187	1	189	263	60	...	...	
79	Bhanisra Kalan	149	1	148	144	61	...	...	
80	Borhana	531	3	656	843	188	2	...	
81	Dhanlan	267	2	229	252	88	2	...	
82	Gochi	315	2	329	464	129	2	...	
83	Lakhriya	68	1	89	96	43	...	...	
84	Kharhor	444	1	506	442	183	7	...	
85	Chora	1,333	5	1,360	1,620	421	9	...	
86	Bhaproda	521	1	591	724	156	2	...	
87	Kooltana	235	1	294	379	93	3	...	
88	Gadhi Sampla	192	1	232	232	73	1	...	

and Sirsa (*H T Pease*) **OXEN**

ROHTAK DISTRICT
Sampla Tahsil

Statement showing the n n ber of cattle pres nt in ea h v ll ge of the Rohtak District—con nu ed

Number	Names of Villages	Number of cows	Num er cf bulls	Number of bu locks	Number of calves	Number f buffalo cows	Number f buffa o e s	Numb r of d na y b e l bu	Remarks
89	Asenda	151	1	112	1 0	[illegible]0	1		
90	Sampla	353	1	321	353	[illegible]5	5		Jungle
91	Ko airor	445		548	600	169	4		
9[illegible]	Madana I alan	111	2	134	167	6	3		
93	Madana Kl oord	123	1	144	141	40			
94	Cl uchi	176	1	164	[illegible]37	4	3		
95	Sar ya	145	1	147	184	58			
96	Datoor	148	1	170	180	5	1		
97	Gandhra	302	1	3 3	331	144	4		
98	Kahasma	5 3	3	539	654	197	3		
99	Kasra nt	1 9	1	182	01	78	[illegible]		
100	Kher Sampla	34		[illegible]39	3 6	89	1		
101	Bhan S ra	135	1	70	[illegible]	69	1		
10[illegible]	Karour	174	1	221	49	8	1		Jungle
103	Rewar khera	1[illegible]2	2	08	[illegible]42	100	4		
104	Kher Isra	153	2	183	[illegible] 6	60	1		
105	Choohyana	331	1	300	324	94	4		
106	Dee vana	53	1	48	41	1[illegible]			
107	Ismarla	833	2	944	1 079	[illegible] 8	5		
108	Sam Chana	459	[illegible]	580	5 3	[illegible] 5	4		
109	Bohyana	440	3	518	571	230	7		
110	Nonanda	177	1	07	63	116	1		
111	Kangton	64	1	88	118	37			
112	D qual	783	10	1 388	1 315	303	7		
113	Raepur								
114	Bham yan								
115	Agarpur								
116	Maj apur								
117	Ba ont	434	3	467	482	19	1		
118	Roo k	460	1	131	702	[illegible]32	4		
119	Voolanga	106	1	144	223	83			
120	Gorar	324	4	390	546	190	2		
121	N zampur	144	1	217	32	115	1		
122	Moonga i	162	1	170	44	80	1		
123	Bokheta	167	2	259	257	157	1		
124	Asan	230	1	308	34	100	4		
125	Kansala	321	8	370	478	10[illegible]	[illegible]		
126	Humayunpur	[illegible]06	1	259	4 2	164	5		
127	Husangadh	358	10	477	522	139	1		

OXEN.

Cattle of Harriana

ROHTAK DISTRICT.
Sampla Tahsil.

Statement showing the number of cattle present in each village of the Rohtak District—continued.

Number.	Names of Villages.	Number of cows	Number of bulls.	Number of bullocks.	Number of calves.	Number of buffalo cows.	Number of buffalo bulls.	Number of ordinary Desi bulls.	Remarks.
46	Sulanthi . . .	99	1	76	104	25	2	...	
47	Mehdipar . . .	82	1	94	79	19	3	...	
48	Dabodakalan . .	94	1	115	122	49	...	...	
49	Daboda Khoord .	243	1	261	294	92	2	...	
50	Dalailpur . . .	31	1	44	39	21	...	...	
51	Loda Khoord . .	152	2	209	218	85	1	...	
52	Lya Majra . .	168	...	383	364	121	2	...	
53	Sarar Aurangabad .	85	2	125	88	39	1	...	
54	Khaidka Musalman .	25	1	35	34	17	...	...	
55	Saidah . . .	270	2	236	286	69	...	...	
56	Tandahairi . .	84	1	123	153	39	1	...	
57	Kasar . . .	110	1	133	194	36	2	...	
58	Sankhoul . . .	133	3	204	238	61	1	...	Jungle.
59	Bamnauli . . .	209	1	272	449	115	2	...	Do.
60	Makundpur . .	40	1	35	34	12	...	...	
61	Kananda . . .	361	2	404	506	132	5	...	Jungle.
62	Khairpur . . .	54	1	61	98	24	...	...	
63	Ladron . .	242	1	297	297	136	3	...	Jungle.
64	Kalasee . . .	272	1	346	404	178	2	...	
65	Asoda . . .	404	2	722	677	334	4	...	
66	Barahee . . .	131	2	397	387	184	2	...	
67	Jhakhoda . .	159	1	210	308	57	1	...	
68	Sodhpur . . .	...	...	...	...	...	...	...	
69	Mandanthe . .	813	3	1,075	1,032	358	3	...	
70	Rohad . . .	524	1	555	756	157	1	...	
71	Dehkora . . .	137	1	180	160	100	...	...	
72	Lahorihairi . .	198	1	154	235	63	...	...	
73	Atæl . . .	243	2	355	370	172	4	...	
74	Morekheri . .	174	1	278	269	113	3	...	
75	Kherisadh . .	213	1	211	319	39	3	...	Jungle.
76	Nayabas . . .	135	..	187	269	95	1	...	
77	Giji . . .	127	1	60	234	86	2	...	
78	*Bhanisthra Khoord* .	187	1	189	263	60	...	...	
79	Bhanisra Kalan .	140	1	148	144	61	...	..	
80	Borhana . . .	531	3	656	843	188	2	...	
81	Dhanian . . .	267	2	229	252	88	2	...	
82	Gochi . . .	315	2	329	464	129	2	...	
83	Lakhriya . . .	68	1	89	96	42	...	...	
84	Kharhor . . .	444	1	506	442	182	7	...	
85	Chora . . .	1,333	5	1,360	1,620	421	9	...	
86	Bhaproda . .	521	1	591	724	156	2	...	
87	Kooltana . . .	235	1	291	379	92	3	...	
88	Gadhi Sampla .	192	1	232	232	73	1	...	

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ROHTAK DISTRICT
Sampla Tahsil

Statement showing the number of cattle present in each village of the Rohtak District—continued

Number	Names of Villages	Number of cows	Number of bulls	Number of bullocks	Number of calves	Number of b ffalo cows	Number of buffalo bulls	Number of ordinary Desi b l s	Remarks
89	Asenda	151	1	112	170	39	1		
90	Sampla	353	1	321	353	35	5		Jungle
91	Koraivor	448	2	548	600	169	4		
92	Madana Kalan	111	2	134	167	62	3		
93	Madana Khoord	123	1	144	141	40			
94	Chochi	176	1	164	277	4	3		
95	Sariya	145	1	147	184	58			
96	Datoor	148	1	170	180	51	1		
97	Gandhra	302	1	323	331	144	4		
98	Vakasma	523	3	539	654	197	3		
99	Kasrainti	129	1	182	201	78	2		
100	Kheri Sampla	234		239	326	80	1		
101	Bhani Swa	135	1	70	222	69	1		
102	Karour	174	1	221	249	8	1		Jungle.
103	Rewarikl era	1.2	2	.08	242	100	4		
104	Kheri Isra	153	2	183	216	60	1		
105	Choohyana	331	1	300	324	94	4		
106	Dee vana	53	1	48	41	13			
107	Ismarla	833	2	944	1 079	318	5		
108	Sam Chana	459	2	580	523	225	4		
109	Bohyana	440	3	518	571	23	7		
110	Nonanda	177	1	.07	263	116	1		
111	Kangton	64	1	88	118	37			
112	D qual	783	10	1 388	1 315	303	7		
113	Raepur								
114	Bham yan								
115	Agarpur								
116	Majrapur								
117	Ba ont	434	3	467	482	19	1	--	
118	Roorki	460	1	131	702	[illegible]	4		
119	Voolangi	106	1	144	223	83			
120	Gorar	324	4	390	546	19.	2		
121	Nizampur	144	1	217	3 2	115	1	--	
122	Moongan	162	1	170	.44	8.	1		
123	Bokheta	167	2	259	257	15	1		
124	Asan	230	1	305	34	100	4		
125	Kansala	3 1	8	370	4 8	10.	2		
126	Humayunpur	2 6	1	259	4 2	104	5	---	
127	Husangadh	358	10	477	5 .	13	1		

OXEN.

ROHTAK DISTRICT
Gohana Tahsil

Cattle of Harriana

Statement showing the number of cattle present in each village of the Rohtak District—continued

No	Names of Villages	Number of cows	Number of bullocks	Number of calves,	Number of buffalo calves	Number of buffalo cows	Number of buffalo bulls	Remarks
	Gohana.							
1	Ahulana	470	582	395	351	441	16	
2	Thaska	88	99	55	53	71	4	
3	Ahmedpurmajra	113	126	111	104	98	2	
4	Gangesor	68	100	79	66	89		
5	Khandrai	209	165	163	74	91	5	
6	Bechpari	447	560	335	343	417	5	
7	Boroda	692	1,120	617	658	668	35	Jungle.
8	Khanpur Khoord	89	67	83	77	60	6	Do.
9	Bunwara	217	169	167	85	91	5	Do
10	Bhondri	49	73	67	50	33		
11	Khelpeh	42	61	40	8	10		
12	Batana	917	1 255	816	488	976	34	
13	Bhawar	362	330	366	403	379	34	
14	Nizampur	235	225	219	148	162	4	
15	Bhamswan Khoord	217	259	170	139	194	12	Jungle
16	Mahra	130	271	109	195	249	4	
17	Mirzapur Kheri	161	212	143	141	169	14	
18	Chichrana	297	395	269	366	305	14	
19	Dhanana Allahoodpur	467	397	327	19[illegible]	286	3	Jungle
20	Chapra	81	72	62	23	39	1	
21	Sikandarpur Majra	271	88	114	89	131	1	Jungle
22	Rebrah	268	412	205	267	333	7	Do
23	Ran[illegible]hana	271	715	404	297	454	33	
24	Rookhi	292	238	208	123	277	4	Jungle
25	Gahlour Kalan	268	256	194	122	167	6	
26	Gahlour Khoord	89	61	53	23	40	1	
27	Sewana Mal	468	408	402	329	371	12	
28	[illegible]ama Kheri	93	106	75	74	65	3	
29	Noornakhera	229	189	159	93	156	7	
30	[illegible]sanpur Kheri	188	207	110	107	156	7	
31	Kathoora	784	694	675	432	468	14	Jungle
32	Gangana	404	643	379	401	276	2	
33	Gohana	551	673	459	213	548	18	Jungle
34	Girhwal	304	579	497	265	641	10	
35	Kotla	204	152	225	120	107	2	
36	Ma[illegible]	447	4[illegible]72	301	[illegible]	473		Jungle
37	M[illegible]ame[illegible]pur	373	456	352	3[illegible]	357	2	
38	Sagor	151	206	178	83	133		
39	[illegible]orar [illegible]an[illegible]lar Khan	73	76	84	42	42		
40	G[illegible] Kalan	65	75	78	40	45		
41	G[illegible]	51	72	54	51	67		
42	Ho[illegible]	310	304	2[illegible]5	121	241	8	
43	B[illegible]	47	70	39	51	71	1	
44	B[illegible] Kalan	3[illegible]9	714	3[illegible]5	414	452	8	Jungle
45	Bh[illegible] Kalan	74	85	90	57	39	1	Do

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and Susa. (*H. T. Pease*)

OXEN.

ROHTAK DISTRICT.
Gohana Tahsil

Statement showing the number of cattle present in each village of the Rohtak District—continued.

Number	Names of Villages	Number of cows	Number of bullocks	Number of calves	Number of buffalo calves	Number of buffalo cows	Number of buffalo bulls	Remarks
45	Bosana	271	402	333	349	321	6	
47	Jallsı	463	696	346	570	690	24	
48	Jasrana	204	298	145	117	16	2	
49	Gabwana	215	261	195	101	106	4	
50	Johras	332	317	157	199	251	22	Jungle
51	Joli	310	495	362	300	321	9	
52	Cherana	255	481	217	255	355	13	Jungle
53	Mathend	214	203	156	112	195	3	
54	Chatera	83	221	190	190	223	7	
55	Dhorana	143	173	145	117	137	10	
56	Khanpur Kalan	608	899	599	577	609	10	
57	Kelana	50	46	29	13	21		
58	Sersaneh	174	130	67	78	92	6	
59	Sewankeh	100	113	7[illegible]	97	73	9	
60	Koskana	31	48	38	42	31		
61	Kahut	431	527	311	183	284	5	
62	Sarquthal	259	431	258	183	284	5	
63	Kasaindi	239	315	208	146	219	4	
64	Kasaindeh	145	220	135	58	127	3	
65	Rabwara	184	228	159	121	159	2	
66	Resal	405	236	704	370	347	13	
67	Khere Dam Khan	250	409	218	200	229	2	
68	Nart	92	137	95	96	126	1	
69	Gaonrl	154	263	129	132	167	5	
70	Barantia	151	199	154	64	88	2	
71	Lidhal	159	273	127	164	202	3	
72	Lath	377	485	292	261	401	13	
73	Moothi	247	271	273	181	172	2	
74	Poothi	216	209	247	141	158	4	
75	Balu	103	127	109	72	86	3	
76	Shanera	492	727	351	309	533	16	
77	Khatwal	147	309	456	291	227	1	
78	Mandlana	829	1,019	608	539	614	17	
79	Bhawri							
80	Khanpur Khoord							Jungle
81	Mohamedpur							
82	Besana							
83	Modlona							

OXEN	Cattle of Harnana
HISSAR DISTRICT. Bhiwani Tahsil	

Appendix B.

List of villages in the Bhiwani Tahsil and number of cattle in each

No	Names of Villages	Number of cows with cow calves	Number of bullocks with bull calves	Number of buffalo cows	Number of buffalo bulls	Number of bulls
1	Sai	279	192	126	24	
2	Sarsa	87	60	30	14	
3	Phoolpura	111	93	34	4	
4	Rewari	272	194	80	30	..
5	Chang	1,030	1,072	432	85	8
6	Mita Thal	816	757	232	56	
7	Ghosh Kani	369	356	130	37	
8	Tigri					.
9	Khosra	377	285	144	43	
10	Tegrana	1,150	904	370	106	.
11	Goojrani	259	314	95	24	.
12	Paloowas	328	314	99	18	.
13	Nathoowas	199	230	89	24	
14	Kaloowas	146	128	35	18	
15	Bamla	970	894	338	40	
16	Naurangabad	88	83	27	2	
17	Nanan	38	26	6	1	
18	Konte	177	169	38	7	..
19	Dhana Ladanpura	196	171	44	12	
20	Dhana Narsan	111	111	8	4	
21	Jaunpal Bhiwani	1,070	842	154	47	
22	Lohar Bhiwani	1,471	1,199	232	77	..
23	Rajpura	79	56	3	1	
24	Baporeh	1,240	977	226	63	8
25	Deosar	1,015	812	115	33	.
26	Dinode	763	933	121	60	
27	Bhiran	408	259	87	16	
28	Dang Kalan	200	157	86	20	
29	Dang Khoord	189	162	45	16	
30	Rewasseh	710	504	80	21	
31	Siglan	487	325	87	12	.
32	Alakhpura	173	141	44	12	
33	Tosham	501	554	115	23	2
34	Ishanak	461	399	138	27	
35	Panjukhera	223	112	15	7	
36	Dadam	171	62	17	3	..
37	Biganswala	234	[illegible]	50	6	.
38	Dhamri	145	99	11	4	
39	Kherkheri Sohan	187	85	59	19	
40	Kherkheri Makawan	238	170	52	16	.
41	Dharan	159	115	21	8	..
42	[illegible]	200	123	75	4	
43	Sagana Kalan	200	122	63	16	
44	Sagana Khoord	121	89	61	19	
45	Gowa	...				

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and Sirsa. (*H T Pease*)

OXEN

HISSAR DISTRICT

Bhiwani Tahsil

List of villages in the Bhiwani Tahsil and number of cattle in each—continued

No.	Names of Villages	Number of cows with cow calves	Number of bullocks with bull calves	Number of buffalo cows	Number of buffalo bulls	Number of bulls
46	Rani Mahoo . . .	573	372	40	8	
47	Bajneh .	[illegible]02	413	29	8	
48	Kohar . .	446	300	40	10	
49	Mahoawas Kohar .	108	69	19	3	
50	Mahoawas Deosar .	48	25	2		
51	Koosumbhi .	164	100	5	2	
52	Telani	167	85	8	1	
53	Lohani .	1,002	471	81	43	
54	Asalwas Wadeha	167	89			
55	Asalwas Narina .	318	176	14	11	
56	Bhakhra .	164	75	6	1	
57	Nigla .	132	74	45	6	
58	Dhani Brahmna	188	124	6	3	
59	Hatampura .	603	390	29	9	
60	La garnenan	308	143	37	14	
61	Jaitwanabas	147	91	16	4	
62	Laigabhanan	304	193	27	4	
63	Nakteh	322	147	47	7	
64	Golagarh	181	151	16	5	
65	Dhangar .	204	132	12	3	
66	Jooi Khoord	683	299	52	17	
67	Jooi Kalan	230	117	18	3	
68	Pohkarwas	186	104	20	2	
69	Lalawas	102	51	1		
70	Kooral	714	470	70	8	
71	Ind wali	519	236	43	9	
72	Ka ru Karrow	2,602	1,558	156	61	
73	Deoralah .	552	367	8	17	
74	Hissan .	373	138	41	13	
75	Salehwaleh	231	134	19	6	
76	Sendoaheh . .	617	317	51	16	
77	Soongarpur	5[illegible]6	250	70	14	
78	Alampur . .	510	310	78	23	
79	Patodhi .	301	156	34	9	
80	Badalwaleh .	65	42	2	6	
81	Thelore .	245	114	16	17	
82	Sarel .	343	217	20	9	
83	Baroleh .	265	151	49	9	
84	Chepar Raigran .	185	120	12	1	
85	Chepar Jogiyan .	166	62	11	5	..
86	Deryapur .	508	238	27	9	..
87	Garenpur . .	369	208	54	26	...
88	Chenaneh .	83	53	9	5	
89	Miran . .	737	347	54	15	
90	Bhereh . .	344	149	49	17	
91	Sedhan . .	235	61	15	6	..
92	Jhelli . . .	250	89	16	4	..
93	Dhanwas	2[illegible]0	109	40	12	...

OXEN.	Cattle of Harriana

HISSAR DISTRICT
Bhiwani Tahsil

List of villages in the Bhiwani Tahsil and number of cattle in each—continued

No	Names of Villages	Number of cows with cow calves	Number of bullocks with bull calves	Number of buffalo cows	Number of buffalo bulls	Number of bulls
94	Khana	191	86	42	10	.
95	Bosan .	240	1[illegible]9	27	7	.
96	Rodla . .	352	[illegible]07	46	15	. .
97	Katwa . .	19[illegible]	95	38	8	
98	Medhan .	383	170	46	20	
99	Dewasras	246	121	36	17	
100	Isherwal	381	154	59	5	
101	Tevani .	229	124	36	9	
102	Mandholi . .	5[illegible]5	[illegible]50	20	2	
103	Mithi .	2[illegible]9	194	43	15	
104	Soorpura Khoord .	[illegible]77	161	45	9	
105	Soorpura Kalan .	370	192	23	10	
106	Behel . .	734	411	50	19	
107	Sodiwas . .	2,0	101	36	4	
108	Patwar .	371	223	71	26	
109	Geròh . .	408	191	49	9	
110	Morkeh . .	[illegible]01	125	27	12	
111	Metani . .	331	140	30	14	
112	Sewaneh .	201	69	9	1	
113	Beediwan .	4[illegible]1	210	51	14	
114	Koolani .	260	103	22	2	
115	Kaland . . .	567	1[illegible]2	61	11	
116	Gorda . . .	293	120	30	11	
117	Gheglana .	249	71	52	6	
118	Bhakranwali Dhani .	22[illegible]	67	37	9	
119	Jhoompeh Khoord	110	43	17	5	
120	Jhoompeh Kalan	605	315	51	39	
121	Lulus	314	60	48	8	
122	Boodh Sahib .	[illegible]86	200	29	22	
123	Mealah	214	68	15	13	
124	Khar Khari .	42	31	9		
125	Cadhwa	[illegible]71	2[illegible]9	[illegible]4	10	
126	Khereh .	1[illegible]2	59	11	1	
127	Dhool Koat .	151	107	[illegible]6	5	
128	Sewani .	950	481	133	43	
129	Kakral .	138	78	40	7	
130	Dhani Soobhanwali	214	60	8	3	
131	Garereh . . .	4[illegible]1	164	73	31	
132	Naloi .		1 7	35	1[illegible]	
133	Barwa .		431	168		

and Sirsa. (*H. T. Pease.*)

List of villages of the Hansi Tahsil and number of cattle in each.

No.	Names of Villages.	Number of cows	Number of bullocks.	Number of calves.	Number of buffalo cows.	Number of buffalo bulls.	Number of bulls.
1	Chan	85	91	86	121	35	...
2	Barbhori	90	227	226	130	9	...
3	Sandlana	140	158	164	90	...	...
4	Kapro	590	559	867	331	...	...
5	Sotha	72	87	112	62	6	...
6	Bhadakhera	46	67	66	24	1	...
7	Pinari	650	220	150	238	12	...
8	Sarsana	195	139	199	150	4	...
9	Kharak	295	407	551	276	...	..
10	Gianpura	69	73	80	62	...	...
11	Biana Khera	245	188	451	106	3	...
12	Dhadah	125	118	127	70	3	...
13	Badhawar	412	424	356	219	4	...
14	Gorafe	400	382	384	162	...	...
15	Datas	832	548	527	166	4	...
16	Massudpur	420	370	632	125	2	...
17	Sangna Ragho	177	158	257	97		...
18	Seendharh	72	85	112	49	..	...
19	Khanpur	127	157	256	135	...	...
20	Rajhe	423	369	359	249	7	...
21	Soola Khnee	130	134	110	38	1	...
22	Gherae	415	395	419	185	1	...
23	Kharkhari	173	164	183	88	...	...
24	Khokha	122	94	142	67	...	...
25	Raman	80	72	76	50	...	...
26	Dandheri	183	102	145	88	..	...
27	Omra	503	496	854	249	2	...
28	Sultanpur	417	371	215	346	...	...
29	Dhannya	151	113	77	8	3	...
30	Roowari	336	252	533	112	2	...
31	Mejahedput	175	151	279	103	1	...
32	Bhalawas	56	73	184	24	4	...
33	Nelweh	340	149	205	81	2	...
34	Ratereh	565	300	440	201	7	...
35	Ronath	185	135	175	38	20	...
36	Shippor	121	116	94	55	3	...
37	Bohal	116	72	111	30	...	...
38	Karawar	351	316	294	140	8	...
39	Bhoortana	133	147	119	26	2	...
40	Jemalpur	536	561	724	279	4	...
41	Hajimpur	184	166	200	36	9	...
42	Aurangnagar	1	5	5	4	...	...
43	Paposeh	212	175	174	105	2	...
44	Bewani	741	646	697	350	2	...
45	Soomrakhera	34	16	32	9	1	...
46	Bilyali	987	949	1,102	396	59	...
47	Taga	..	...	..	...	...	...
48	Sooi	241	202	268	130	2	...

OXEN.	Cattle of Harnana

HISSAR DISTRICT
Bhiwani Tahsil

List of villages in the Bhiwani Tahsil and number of cattle in each— continued

No	Names of Villages	Number of cows with cow calves	Number of bullocks with bull calves	Number of buffalo cows	Number of buffalo bulls	Number of bulls
94	Khawa	191	86	42	10	
95	Bosan	240	129	27	7	
96	Rodha	3[illegible]2	207	46	15	
97	Katwa	19[illegible]	95	38	8	
98	Medhan	38[illegible]	170	46	20	
99	Dewasras	246	121	36	17	
100	Isherwal	381	154	59	5	
101	Tewan	229	124	36	9	
102	Mandholi	525	[illegible]50	20	2	
103	Mithi	289	194	43	15	
104	Soorpura Khoord	[illegible]77	161	45	9	
105	Soorpura Kalan	370	19[illegible]	23	10	
106	Behel	734	411	50	19	
107	Sodiwas	270	101	36	4	
108	Patwar	371	223	71	26	
109	Gerôh	408	191	48	9	
110	Morkeh	201	125	27	12	
111	Metani	331	140	30	14	
112	Sewaneh	201	69	9	1	
113	Beedwan	421	210	51	14	
114	Koolani	260	103	22	2	
115	Kaland	567	1[illegible]2	61	11	
116	Gorda	293	120	30	11	
117	Gheghana	249	71	52	6	
118	Bhakranwali Dhani	22[illegible]	67	37	9	
119	Jhoompeh Khoord	110	43	17	5	
120	Jhoompeh Kalan	60[illegible]	315	51	39	
121	Lulus	314	60	48	8	
122	Hool[illegible] Sal[illegible]	386	200	29	22	
123	Mealah	214	88	15	13	
124	Khar Khari	42	11	9		
125	Cadhwa	371	2[illegible]9	64	10	
126	Khereh	1[illegible]2	59	11	1	
127	Dhool Koat	151	107	26	5	
128	Sewani	950	481	133	43	
129	Kakral	138	78	40	7	
130	Dhani Soobhanwal	214	60	8	3	
131	Garereh	4[illegible]1	164	73	33	
132	Nalo[illegible]	3[illegible]9	1[illegible]7	35	18	
133	Barwa	928	434	168	39	

and Sirsa. (*H. T. Pease.*)

OXEN.

HISSAR DISTRICT.
Hansi Tahsil.

List of villages of the Hansi Tahsil and number of cattle in each.

No.	Names of Villages	Number of cows.	Number of bullocks.	Number of calves.	Number of buffalo cows.	Number of buffalo bulls.	Number of bulls.
1	Chan . . .	85	91	86	121	35	...
2	Barbhori . .	93	227	226	130	9	...
3	Sandlana . .	140	158	164	90	...	...
4	Kapro . . .	593	559	867	331	...	...
5	Sotha . . .	72	87	112	62	6	...
6	Bhadakhera . .	46	67	66	24	1	...
7	Pinari . .	650	220	150	238	12	...
8	Sarsana . . .	195	139	199	150	4	...
9	Kharak . . .	295	407	551	276	...	..
10	Gianpura . . .	69	71	83	62	...	...
11	Bana Khera . .	245	168	451	106	3	...
12	Dhadah . . .	125	118	127	70	3	...
13	Badhawar . . .	412	424	356	219	4	...
14	Gorade . . .	420	382	384	162	...	...
15	Datas . . .	832	548	527	166	4	...
16	Masudpur .	420	370	632	125	2	...
17	Sangna Ragho . .	177	158	257	97		...
18	Seendharh . .	72	85	112	49	...	...
19	Khanpur . . .	127	157	256	135	...	..
20	Rajhe . . .	423	369	359	249	7	...
21	Soola Khnee . .	130	134	110	38	1	...
22	Gherne . . .	415	305	419	185	1	...
23	Kharkhari . .	173	164	183	88	...	...
24	Khokha . . .	122	94	142	67	...	...
25	Baman . . .	80	72	76	50	...	...
26	Dandheri . . .	183	102	145	88	...	...
27	Omra . . .	503	496	854	249	2	...
28	Sultanpur . . .	447	371	215	346	..	...
29	Dhannya . . .	151	113	77	8	3	..
30	Roowari . . .	336	252	533	112	2	...
31	Mejahedput . .	175	151	279	103	1	...
32	Bhalawas . . .	56	73	184	24	4	...
33	Nelweh . . .	340	149	205	81	2	...
34	Ratereh	565	300	440	201	7	...
35	Ronath . .	185	135	175	38	20	...
36	Shippor . . .	121	116	94	55	3	...
37	Bohal . . .	116	72	111	30	...	...
38	Karawar . . .	351	316	294	140	8	...
39	Bhoortana . .	133	147	119	26	2	...
40	Jemalpur . . .	536	561	724	279	4	...
41	Hajimpur . . .	184	166	200	36	9	...
42	Aurangnagar . .	1	5	5	4	...	...
43	Paposeh . . .	212	175	174	105	2	...
44	Bewani . . .	741	646	697	380	2	...
45	Soomrakhera . .	34	16	32	9	1	...
46	Bilyali . . .	987	949	1,102	396	59	...
47	Taga . . .	..	...	..	...	...	...
48	Sooi . . .	241	202	268	130	2	...

OXEN.

HISSAR DISTRICT
Hansi Tahsil

Cattle of Harriana

List of villages of the Hansi Tahsil and number of cattle in each—
continued

No	Names of Villages	Number of cows	Number of bullocks	Number of calves	Number of buffalo cows	Number of buffalo bulls	Number of bulls
49	Lohari Jathoo	618	462	595	171	14	
50	Madhana	414	296	451	115		
51	Dhenaneh	966	670	1,202	196	3	.
52	Bedaisreh	409	296	425	99		
53	Jetai	191	117	159	63	1	
54	Taloo	726	468	540	191	4	
55	Poor	304	351	408	120	4	
56	Sewareh	160	97	170	49		...
57	Sewaneh	347	244	317	105	8	
58	Menleh	599	370	640	150	8	
59	Kherkhera	80	150	143	50	1	
60	Bhatoul Jatan	276	249	340	110	1	
61	Bhatoul Rangran	90	60	83	35	3	
62	Badaleh	2[illegible]5	239	133	110	9	
63	Kherheleh	351	263	214	172	15	
64	Seeoer	163	278	350	122	2	
65	Sorkhee	253	213	160	129	1	
66	Koongarh	737	540	480	227	2	
67	Madahel Kalan	129	107	126	47	1	
68	Bandaheri	113	111	166	60	1	
69	Madahel Khoord	[illegible]60	420	412	207	1	
70	Madanheri	315	274	401	137	1	
71	Sangwa	387	259	385	13[illegible]	10	
72	Sarsanpoo hi	67[illegible]	527	[illegible]75	255	2	
73	Bas Khoord Bejan	2[illegible]7	240	279	1[illegible]3		
74	Bas Badshahpur	[illegible]81	314	102	205	1	
75	Bas Akbarpur	199	153	186	97	5	
76	Bas Azamshahpur	152	150	124	59		
77	Bhakhneh	159	161	256	100	1	
78	Kheri Ramgran	69	44	8[illegible]	45		
79	Mahleh	125	119	[illegible]66	77	[illegible]	
80	Barchapar	76	177	369	70		
81	Gorkarii		.				
82	Kanikheri	2[illegible]6	1[illegible]0	218	103	1	
83	Bagsoleh	290	252	417	218	9	
84	Khoate Kalan	7[illegible]9	614	[illegible]54	332	87	
85	Khote Khoord	181	155	314	81	1	
86	Gaolas						
87	[illegible]arch	1[illegible]	147	204	83	3	
88	Keenr	77	125	171	83	1	
89	Rakhra Khas	280	2[illegible]5	2[illegible]0	176	2	
90	Kheri [illegible]ab	155	1[illegible]	150	44		
91	Kheri Jalab	347	2[illegible]5	3[illegible]0	109	1	
92	Hajampur	185	115	[illegible]9	73	3	
93	Ganra	1[illegible]8	123	9[illegible]	6[illegible]	1	
94	Lakhi Shahpur	240	218	201	9[illegible]	1	
95	[illegible] Paplo	219	277	158	69		
96	Theewa						

and Sirsa (*H T Pease*)

OXEN.

HISSAR DISTRICT
Hansi Tahsil

List of villages of the Hansi Tahsil and number of cattle in each—continued

No	Names of Villages	Number of cows	Number of bullocks	Number of calves	Number of buffalo cows	Number of buffalo bulls	Number of bulls
97	Saladheri						
98	Kajab						
99	Sisae Boola	438	506	477	346	11	
100	Sisae Kal raman	898	476	618	321	11	
101	Kher barkaish						
102	Majhad	154	104	123	85	1	
103	Chanout	190	[illegible]92	340	162	3	
104	Bhatleh	360	380	312	170	6	
105	Kolaneh	179	160	143	45	2	
106	Kootubpur	[illegible]03	123	245	48		
107	Deepal	156	73	145	48		
108	Beer						
109	Hansee	1 769	1 [illegible]21	1 674	544	15	
110	Path Mangal Khan	250	165	216	70	30	
111	Barsee	1 [illegible]07	809	946	395	9	
11[illegible]	Dhaneh	741	532	1 027	208	13	
113	Shaikhupura	385	167	248	128	3	
114	Kherigángan	232	167	228	180	4	
115	Jámaori	339	202	269	179	3	
116	Koombeh	418	215	374	121	3	
117	Thoraneh	643	382	48[illegible]	25[illegible]	2	
118	Pálee	306	2 [illegible]8	315	177	5	
119	Rajpureh	85	112	243	79	3	
120	Madá	123	84	169	61	3	
121	Moth Colonel Saheb	230	186	307	82		
122	Moth Rangran	244	202	3 [illegible]1	176	9	
123	Majreh	315	195	207	169	2	
124	Narnoud	806	488	688	443	13	
125	Aurangshahpur	161	98	152	70	1	
126	Badara	300	22[illegible]	121	175	1	
127	Kheri Roge	70	54	79	40		
128	Kher során	74	59	71	52		
129	Mall kpur	124	87	122	90	11	
130	Mirzpur	429	455	687	364	3	
131	Rajethal	508	201	186	208	50	
132	Kagsar	198	70	138	41	2	
133	Soo chanee	417	160	4[illegible]	105	75	
134	Bhainee	376	270	429	[illegible]04	1	
135	Paitwar	505	475	478	285	2	
136	Khanda Kheri	245	385	576	355	16	
137	Jamni Khereh	77	36	51	2[illegible]	2	
138	Ogalan	524	4[illegible]0	380	198	1	

OXEN.

Cattle of Harriana

HISSAR DISTRICT.
Sirsa Tahsil

List of villages and number of cattle in the Sirsa Tahsil of Hissar District—continued

No	Names of Villages	Number of bullocks	Number of cows	Number of buffalo bulls	Number of buffalo cows	Number of calves	Number of Hissar bulls
130	Boodhi Maree	48	24	7	70	38	..
131	Mamera	148	122	6	60	111	
132	Majoo Khera	64	35	12	70	15	
133	Pattiker Palka	41	34	19	38	23	
134	Shaikhu Khera	40	33	4	5	34	
135	Talujarwaleh (urf) Humayun Khera	65	37	7	32	56	
136	Nagrana	8	12	21		11	
137	Ranera	687	300	159	397	431	
138	Abhauli	53	21	7	29	60	
139	Otta	65	78	4	17	53	
140	Abootgarh	19	11	3	1	11	.
141	Chak Painyawaleh (urf) Chak (1st)	104	56	2	18	63	
142	Chak Janewa			...			...
143	Dhanoor	103	59	2	66	77	.
144	Alanoor (urf) Alaha Noor	53	71	2	46	110	..
145	Chorur	172	125	3	75	125	..
146	Ketania	118	87	5	45	83	
147	Chamel	175	130	14	63	140	.
148	Bansolrar	30	92	3	40	191	
149	Ahmedpur, near Sirsa	15	33		14	27	.
150	Meerpur	45	41		9	55	
151	Khaireka	66	82		18	83	
152	Soharna	45	35		32	39	
153	Jhonpra	52	29		17	42	
154	Nezadalla Kalan	200	129	2	65	153	.
155	Nezadalla Khoord	77	74	2	60	53	
156	Malewaleh (urf) Rajengarh	91	51		24	54	
157	Boodha Bhana	136	113		29	98	1
158	Farwain	140	90	15	25	39	

and Sirsa (Hissar) | OXEN

List of villages and number of [illegible] in the Sirsa Tahsil of Hissar District—continued.

HISSAR DISTRICT, Sirsa Tahsil.

No.	Names of Villages	Number of [illegible]	Number of [illegible]	Number of [illegible]	Number of [illegible]	Number of [illegible]	Number of [illegible]
171	Rohan . . .	44	46	7	14	48	
172	Mallree . . .	93	74	21	32	70	
173	Bhewan . . .	138	131	2	40	118	
174	Theraj, with two Chaks	116	71	1	51	[illegible]	
175	Panj Mala .	36	41		11	92	
176	Aluka, near Bhima .	213	162	4	83	161	
177	Jesih . . .	150	95	1	81	110	
178	Bap	153	201	2	64	170	
179	Chak Bannih . .		..		..		
180	Sawayipur . .	7	16		8	16	
181	Boorj Dhanpoo . .	81	101	5	52	47	
182	Dhala (urf) Bahrajpur	75	40	4	53	45	
183	Beerwalagoodha	123	115	2	71	110	
184	Chorer . .	140	124	4	55	96	
185	Kurango Wali .	141	143	1	64	161	
186	Bahadur Khera (urf) Bahadra . .	38	61		15	56	
187	Sookh Chain . .	223	184	1	114	210	1
188	Soolaywalla .	76	67	2	12	48	
189	Daulatpura . .	27	62	2	11	79	
190	Goodha Kalan .	198	182	1	75	175	
191	Bhangoo . . .	123	112	6	51	78	
192	Panjuana . . .	87	68	1	51	59	
193	Shaikhapur . .	32	60	1	33	51	...
194	Fatehpur, Nemat Khan	25	38		20	12	
195	Karaingarh . .	83	66		26	83	
196	Sohuwaleh . .	122	115	1	115	155	
197	Chatrian . . .	25	51	1	6	34	
198	Ranghuwana . .	128	127	1	35	113	
199	Anandgarh . .	36	58	2	27	67	
200	Lakarwali . . .	166	99	1	66	159	1
201	Goodrana . . .	135	128		55	122	1
202	Khew Wali, near Anandgarh	50	85		47	75	
203	Chukerian (urf) Chatrawali . . .	82	86	17	31	75	
204	Odhan . .	203	211	1	71	170	1
205	Ruherawali . .	15	44		30	56	
206	Ramnagar .	17	26		14	18	
207	Panniwali Motanawabad . .	41	113	12	26	153	
208	Khoonia (urf) Nipalpur . .	71	47		21	57	
209	Mordwali . .	33	48	2	6	74	
210	Joodhpooria .	27	78		27	67	
211	Dhothar . .	54	175		41	137	
212	Sooltanpur . .	35	43	1	10	38	
213	Nanuana . . .	22	40	1	2	40	

OXEN.

Cattle of Harriana

HISSAR DISTRICT.
Sirsa Tahsil.

List of villages and number of cattle in the Sirsa Tahsil of Hissar District—continued.

No	Names of Villages	Number of bullocks	Number of cows	Number of buffalo bulls	Number of buffalo cows	Number of calves	Number of Hissar bulls
214	Fatehpur (urf) Fatehgarh . .	20	12	..	3	13	..
215	Mangalia . . .	23	20		2	15	...
216	Kharian . . .	70	190	1	62	166	..
217	Dharyawala (urf) Abhul Khair . .	19	17	.	14	11	...
218	Bookhara Khera .	41	38	...	6	22	..
219	Peer Khera . . .	7	38	1	10	26	...
220	Bhagsar . . .	84	55	.	20	28	...
221	Ghookawali . .	86	97	...	31	70	..
222	Khalsharegarh . .	20	38	2	9	32	..
223	Banwala . . .	53	132	2	22	107	...
224	Bhoona (urf) Mokmabad . . .	30	31		3	28	...
225	Moona Khera, near Ranea . . .	61	49	2	26	60	...
226	Koosar . .	144	74	3	52	101	.
227	Mohamedpur, Basnawala . . .	11	18	1	19	37	...
228	Balaser . . .	37	77	7	22	110	...
229	Barholanwali . .	64	68	28	1	73	...
230	Naiwala (urf) Franciswala . .	58	14	1	9	15	...
231	Khwaja Khera near Ranea . . .	35	23	1	3	18	..
232	Dhodanwali . .	121	121	5	19	171	...
233	Alipur, near Kanjarwala . . .	48	78	...	21	40	...
234	Bahiya (urf) Fatehgarh	138	98	16	38	90	.
235	Sainpal . . .	157	64	2	22	32	...
236	Nathoshar . .	187	95	6	87	104	...
237	Bacheer . . .	59	54	..	23	48	..
238	Kaluwana . .	100	99	2	29	109	...
239	Mambar Khera .	19	84	4	18	93	...
240	Mattuwala (urf) Sadharpur . . .	41	36	6	27	29	..
241	Peadaywala (urf) Shaikhu Khera . .	101	35	9	17	33	...
242	Gandran (urf) Seldhera	67	44	1	21	30	...
243	Ghorewali (urf) Nasirpur . . .	20	29	2	8	24	..
244	Chakan (urf) Chakosar	34	66	1	8	56	...
245	Ramgarh . . .	19	27	6	2	22	.
246	Rasalia Khera . .	57	151	3	13	115	...
247	Ratta Khera . .	31	39		2	34	...
248	Rajpura . . .	19	23		..	21	...
249	Nathawali . .	115	149	10	36	61	..
250	Salam Kher	58	90	1	32	84	...

HISSAR DISTRICT
Sirsa Tahsil.

List of villages and number of cattle in the Sirsa Tahsil of Hissar District—continued.

No	Names of Villages	Number of bullocks	Number of cows	Number of buffalo bulls	Number of buffalo cows	Number of calves	Number of Hissar bulls
251	Jafalana . . .	148	110	8	42	91	.
252	Choramar Khera .	114	95	5	21	54	...
253	Rampura, near Ratta Khera . .	66	55	..	29	58	.
254	Jandwala (urf) Jandu wala	47	67	.	15	67	.
255	Gauriwala (urf) Bhagwan Khera . .	50	53	.	8	30	.
256	Modi(urf)Jhurui Khera	45	40	...	10	11	...
257	Chakgalu (urf) Munnawali . . .	5	10		2	7	.
258	Bijuwali . . .	64	55	1	20	45	..
259	Faridpur . .	13	9		2	5	..
260	Kairwala(urf)Hasalpur	62	52		10	38	.
261	Ahmedpur Darawala .	104	100	7	20	75	.
262	Godeka (urf) Gorusar .	63	45		10	31	...
263	Munnawali	27	35		13	27	.
264	Ganga . .	147	241	1	67	190	.
265	Jandwala . . .	20	130		15	35	
266	Bharu Khera (urf) Salehan Khera	11	19		2	6	..
267	Chotala . .	171	318	1	48	139	
268	Asakhera (urf) Moti Khera . . .	20	25	..	7	27	
269	Sookherawala (urf) Sabu Khera .	72	81		8	35	...
270	Taya Khera (urf) Jassa Khera . . .	20	52	1	1	16	
271	Boobshahr .	174	141	1	21	66	...
272	Sakta Khera(urf)Bhodlerkhon . .	187	104	...	54	115	..
273	Logarh . .	171	111		44	76	1
274	Fatehpur Jootanwali .	179	120		27	51	..
275	Sharegarh .	115	89		25	66	.
276	Alika, near Masitan .	220	15	2	67	83	1
277	Nawabwali (urf) Aspan Khera . .	...					...
278	Dabwali . .	381	187	2	123	222	...
279	Jogewala . .	164	92	2	51	60	1
280	Panniwali Mehreka	132	61		51	60	...
281	Daisa Jodha (urf) Bhai Jodhka . . .	334	231	2	96	220	..
282	Mangiana .	149	89	2	66	156	
283	Sanwat Khera . .	90	41	2	34	53	..
284	Masitan .	388	148	8	95	205	.
285	Gobindgarh Khera Masitan .	8	9			9	...
286	Lakhindana .	60	50	1	21	41	...
287	G dar Khera . .	19	7		3	8	...

OXEN.

Cattle of Harriana

HISSAR DISTRICT.
Sirsa Tahsil.

List of villages and number of cattle in the Sirsa Tahsil of Hissar District—continued.

No.	Names of Villages.	Number of bullocks.	Number of cows.	Number of buffalo bulls.	Number of buffalo cows	Number of calves.	Number of Hissar bulls.
214	Fatehpur (urf) Fatehgarh	20	12	...	3	13	...
215	Mangalia	23	20	..	2	15	...
216	Kharian	70	190	1	62	166	...
217	Dharyawala (urf) Abhul Khair	19	17	...	14	11	...
218	Bookhara Khera	41	38	...	6	22	...
219	Peer Khera	7	38	1	10	26	...
220	Bhagsar	84	55	..	20	28	...
221	Ghookawali	86	97	...	31	70	...
222	Khaisharegarh	20	38	2	9	32	...
223	Banwala	53	132	2	22	107	...
224	Bhoona (urf) Mokmabad	30	31	..	3	28	...
225	Moona Khera, near Ranea	61	49	2	26	60	...
226	Koosar	144	74	3	52	101	..
227	Mohamedpur, Basnawala	11	18	1	19	37	...
228	Balaser	37	77	3	22	110	...
229	Barholanwali	64	68	28	1	73	...
230	Naiwala (urf) Franciswala	58	14	1	9	15	...
231	Khwaja Khera near Ranea	35	23	1	3	18	...
232	Dhodanwali	121	121	5	19	171	...
233	Alipur, near Kanjarwala	48	78	...	21	40	...
234	Bahiya (urf) Fatehgarh	138	98	16	38	90	...
235	Sainpal	157	64	2	22	32	...
236	Nathoshar	187	95	6	87	104	...
237	Bacheer	59	54	...	23	48	...
238	Kaluwana	100	99	2	29	108	...
239	Mambar Khera	19	84	4	18	93	...
240	Mattuwala (urf) Sadharpur	41	36	6	27	29	...
241	Peadaywala (urf) Shaikhu Khera	104	35	9	17	33	...
242	Gandran (urf) Seldhera	67	44	1	21	36	...
243	Ghorawali (urf) Nasirpur	20	28	2	8	24	...
244	Chakan (urf) Chakusar	34	66	1	8	56	...
245	Ramgarh	19	27	6	2	22	...
246	Rasalia Khera	57	151	3	13	115	...
247	Ratta Khera	31	30	.	2	24	...
248	Rajpura	19	23	...	...	24	...
249	Nahlawali	115	149	10	36	94	...
250	Salam Khera	98	90	1	39	84	...

and Sirsa	(*H T Pease*)	OXEN

List of villages and number of cattle in the Sirsa Tahsil of Hissar District—continued

HISSAR DISTRICT
Sirsa Tahsil.

No	Names of Villages	Number of bullocks	Number of cows	Number of buffalo bulls	Number of buffalo cows	Number of calves	Number of Hissar bulls
251	Jalalana	148	110	8	42	91	
252	Choramar Khera	114	95	5	21	54	..
253	Rampura, near Ratta Khera	66	55		29	58	
254	Jandwala (urf) Janduwala	47	67		15	67	
255	Gauriwala (urf) Bhagwan Khera	50	53		8	30	
256	Mod (urf) Jhurui Khera	45	40		10	11	
257	Chakgalu (urf) Munnawala	5	10		2	7	—
258	B jowali	64	55	1	20	45	
259	Faridpur	13	9		2	5	
260	Ka rwala (urf) Hasalpur	62	5[illegible]		10	38	
261	Ahmedpur Darawala	104	100	7	20	75	
262	Godeka (url) Gorusar	63	45		10	31	
263	Munnawali	27	35		13	27	
264	Ganga	147	241	1	67	190	
265	Jaodwala	[illegible]	130		15	35	
266	Bharu Khera (urf) Salehan Khera	11	19		2	6	
267	Chotala	171	318	1	48	159	
268	Asakhera (urf) Moti Khera	20	25		7	[illegible]	
269	Sookherawala (urf) Sabu Khera	72	81		8	35	—
270	Taya Khera (urf) Jassa Khera	20	52	1	1	16	
271	Boobshahr	174	141	1	21	66	—
272	Sakta Khera (urf) Bhodlerkhon	167	104		54	115	—
273	Logarh	171	111		44	76	1
274	Fatehpur Jootanwali	1 9	120		27	51	.
275	Sharegarh	115	89		5	66	..
276	Alika near Mas tan	220	15	2	67	83	1
277	Nawabwali (urf) Aspau Khera						—
278	Dabwali	381	187	2	1[illegible]3	2[illegible]2	
279	Jogewala	164	92	2	51	60	1
280	Panniwali Mehreka	132	81		51	66	
281	Da sa Jodha (urf) Bhai Jodhka	334	231	2	96	[illegible]	
282	Mangiana	149	89	[illegible]	66	156	
283	Sanwat Khera	50	42	2	24	53	
284	Mas tan	398	148	8	95	205	
285	Gob ndgarh Khera Masitan	8	9			9	
286	Lakhindana	60	59	1	21	43	—
287	G dar Khera	19	7		1	8	—

OXEN — **Cattle of Harriana and Sirsa**

HISSAR DISTRICT
Sirsa Tahsil

List of villages and number of cattle in the Sirsa Tahsil of Hissar District—concluded

No	NAMES OF VILLAGES	Number of bullocks	Number of cows	Number of buffalo bulls	Number of buffalo cows	Number of calves	Number of Hissar bulls
288	Lambi (urf) Mohamed pur	97	52		19	39	
289	Jhutti Khera	23	41			39	
290	Math (urf) Daduka math	174	108		53	95	
291	Monjgarh	197	122	1	39	110	
292	Shahwala (urf) Diwan Khera	22	22	1	6	13	
293	Nilawali	78	43		19	63	
294	Haibawana	129	87		36	70	
295	Phoollo	188	181		57	92	
296	Chitta	83	46	1	42	23	
297	T grer	61	48		6	37	
298	Naurang	92	83	1	44	74	
299	Khokher	86	125	1	34	51	
300	Makha	81	50	9	16	33	
301	Paniana	69	31	9	19	29	
302	Panniwali Roolde	140	93	2	57	126	
303	Mathri, near Khoon a	176	91	13	42	80	
304	Malakpur	79	84	1	13	74	
305	Kingran (urf) Bino ite wali	66	45	3	26	52	
306	Tapp (urf) Fattepur Khera Pipli	53	39	[illegible]	5	12	
307	Piplee	212	174	8	30	91	
308	Jagmalwali	247	140	14	90	123	1
309	Asree	145	8[illegible]	1	27	68	
310	Hassu	104	49	1	28	75	
311	Daisumal Kanch	229	172	3	118	157	
312	Kalanwali	394	241	4	105	280	
313	Takhtmal	115	182	8	68	50	
314	Khoonlya	367	141	3	72	115	1
315	Taru vana	166	94	30	42	96	
316	Tiloka	60	40	11	0	38	
317	Khutraon	65	37	1	20	30	
318	Dograwali	18	8	2	4	5	
319	Koomal	33	28		15	35	
320	Pakka	140	95	1	95	147	
321	Didu	204	163	3	92	255	
322	Kewal	161	110	22	55	90	
323	Dharmpura	100	72	13	31	95	
324	Rampura, near S nga pura	141	224	2	84	132	
325	Singpura						

G I C P O—No 496 R. & A D—27 11 96—2 100.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr George Watt, Reporter on Economic Products to the Government of India, Calcutta

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions Contributions or corrections and additions will therefore be most welcome

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series, those on Forestry in the Forest Series Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal kingdom In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series

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This sheet and the title page may be removed when the subject matter is filed in its proper place, according to the letter and number shown at the bottom of each page

THE

AGRICULTURAL LEDGER.

1895—No. 23.

DAIRY FARMING AND DAIRY PRODUCE.

THE INDIAN CHURN:

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. III., D. 14 a.*]

A Précis of Official Correspondence on the Indian Churn—by the EDITOR.

Other Articles that may be consulted:

The Agricultural Ledger No. 17 of 1893 on Dairy Farming and Dairy Produce (Cream Separators).

Butter,	Dict.	Econ.	Prod.,	*Vol. I.*, B. 983.
Dahi	„	„	„	*Vol. III*, D. 15.
Ghi	„	„	„	*Vol III*, G. 189.
Rennet	„	„	„	*Vol VI., Pt I*, R. 73.

CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1895.

Use of churn in ancient times.

interval between the two discoveries, since in the warmer parts of India at least, the difficulty of preserving milk or of carrying it to any ... to-day. ... l articles ... climatic tendencies, must have early become axioms of household eco- ...

the band, would be a natural and simple one, and one which might fairly well have suggested itself spontaneously to the most diverse races. Whether or not the Aryans introduced that particular form of churn that is now very generally used throughout India, may be left as a question for the Ethnologist to solve But what can be affirmed from actual knowledge of the people of to day is that the principle of that churn is known and practised all over the country by people of admitted Aryan origin no doubt, but very largely also by those of non- ...

of the early invaders of India

The following may be given as an abstract of the chief replies that have been given to Herr Martiny's set of questions—grouped, for convenience, province by province. The figures sometimes given within brackets denote the number of the question to which the remarks are intended to be a reply —

BENGAL

I.—**BENGAL.**—Mr N N Banerjee, Assistant to the Director of Land ... "The old Indian Churn" is in ... which are peopled (2) by ... 3) in which the churning is done is called *nara* or *nari* and the churning-stick *mahuna*, but these names, he says, doubtless differ in various tracts, such as in Behar, Orissa, Darjiling, etc. (4) It is the Aryan ... the hillmen of Darjiling employ a ba... Negretic tribes, such as the Kols of ... different kind of churn (5) Every ... (6) With the exception of the bamboo cylinder above referred to, there are no other primitive churns known.

The vessel in which the butter is churned, which may be slightly modified in size and shape in the various districts of the province, is usually ...

Subsequent to the receipt of the above communication, a further letter was obtained from the office of the Director of Land Records and Agriculture which gave, in the following tabular form, an abstract statement of all the replies that had been received from the District Officers of Bengal.—

* The Bhutias use a bamboo and a piston with a circular piece of wood at the further end having four notches cut into it. The motion is vertical up and down instead of rotatory.—*Editor.*

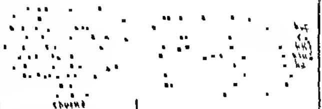
BENGAL.

Analytical Statement of the replies from certain Districts of Bengal

	1	2	3
Name of District from which Information was obtained	Is the old Indian churn as given in the sketch appended to Herr Martiny's letter used in the District? If not, what other kinds of churns are in use?	Are the *Gowalas* of the District of the Aryan or Malayan type?	What is the local vernacular name of the churn used in the District?
Darjiling.	The churning apparatus used on the hills consists of a wooden vessel and a wooden churning stick The churns used by the Bhutias, Lepchas and Nepalese are all made of wood and are similar in construction The Bhutias also churn butter in a bamboo cylinder by means of a wooden churning-stick	The Nepalese are the original inhabitants of Nepal The Brahmans, Chhattris and some Newars amongst the Nepalese are said to be of the Aryan type The Bhutias and Lepchas are of Chinese and Malayan types	The churn is called *Theki* by the Nepalese and *kewdong* and *keokedong* by the Bhutias and Lepchas (*i e.*, the aboriginals of Darjiling including Kalimpong Sikkim and Bhutan).
Mymensingh	The old Indian churn given in the illustration is in use almost throughout Bengal It is known for certain that it is used in the districts of Dacca, Faridpur, Jessore, Birbhum and Mymensingh. It is said to be used also in the several districts of Behar and Orissa.	Aryan . .	The name is *Charkhi* in Bengali and *Hindustani* In Persian it is called *Cherkh* The local name among the *gwhlás* of this district is *Sitkali*.

* This is clearly a misconception, as the concluding sentence shows, and due mainly churned, but sell their surplus milk to traders who churn all the milk so purchased in selling milk instead of butter has its origin also in the religious prejudice that would

[illegible] the [illegible] here [illegible]

1	2	3	
Is the model [illegible] churn given in the sketch the churn of the Aryan population? If not, what kind of churn is used by the Malayan population?	 churns		
......	The *Theki* holds milk from 10 seers to 20 seers and the *Kandung* or *Krokalang* holds milk from 5 seers to 20 seers. Each cow holder has got a churning apparatus for his own use.	The Lepchas often make butter by shaking the milk in bamboo chungas—a method easier for working with small quantities of milk. The Nepalese sometimes put cream into a bottle and shake it with their hands till butter is formed. Servants in the employ of private gentlemen in making butter invariably put cream and little milk in a bottle and shake it till the butter is formed. The natives also prepare butter sometimes in this fashion.	Darjeeling.
Yes, the churn is that of the Aryan population. As regards the kind of churn used by the Malayan population there is no positive information available; but a gentleman who has been to Chittagong and has moved among the *Moghs* population who certainly belong to the Malayan type, states that he has seen the *Moghs* using churns of the kind given in the illustration.	In this district milk is brought from a *long distance to the churn* and this is the case with the professional milkmen who buy milk in the village and bring it for the purpose to their lodgings at some central place. Milk is brought in very large vessels containing from 1 to 2 maunds in each vessel. Among the cultivators they have of course their own churns of smaller size for their own domestic* use.	It is stated that butter is sometimes prepared by shaking the milk with the bare hand, but this can be done only when the milk is small and butter is required for domestic purposes in a family.	Mymensingh.

* In the way in which question C was put. *The milkmen do not usually [illegible] to be larger churns than the milkmen possess [illegible] The [illegible] prevent certain people from eating butter [illegible]*

D. 742.

THE INDIAN — A Precis of Official

BENGAL

Analytical Statement of the replies from certain Districts of Bengal

	1	2	3
Name of District from which information was obtained	Is the old Indian churn as given in the sketch appended to Herr Martiny's letter used in the District? If not what other kinds of churns are in use?	Are the *Gwálás* of the District of the Aryan or Malayan type?	What is the local vernacular name of the churn used in the District?
Noakhali .	The churn in use in this district is the same as the one shewn in the illustration attached to Herr Martiny's letter with this modification that generally two strings instead of one are attached to the churning rod and two persons from opposite sides pull it which keeps it in position and the post to which the rod is tied is dispensed with	The milkmen here who are known as *Gopis* are of the Aryan extraction and originally came from Dacca and Chittagong and settled here It is not known what kind of churn is used by the Malayan population	The churn is known by the term *Mathan* which is the Bengali form of the Sanskrit word *Manthan* from root *Mantha* to churn
Chittagong Hill Tracts	The *Gwalás* here use the same churn as sketched in Herr Martiny's letter	.	

arranged under the headings of Herr Martiny's *questions*—continued.

BENGAL.

	4	5	6
	Is the old Indian churn given in the sketch the churn of the Aryan population? If so what kind of churn is used by the Malayan population?	It is stated that the Indian churn containing 30 to 35 gallons is used by different people who bring their milk sometimes many miles to the churn. What is the reason for doing so? Why has not every cow-holder his own, of course smaller, churn?	Is there any other primitive churn in use in India, or any other old fashion of making butter, i.e., making butter in a bowl by a whirl without using a string or by shaking (beating) the milk only with the bare hand or shaking it in a skin bag like the Arabians and the Baluchis?
Noakhali.	......	The cow-owners of this district being generally Muhammadans keep no churns of their own to prepare butter. The curd prepared by them would not find a sale among the Hindus. They find it, therefore, more profitable to sell milk to the Hindus who do the work of churning. This is also an instance of the Indian mode of division of labour or profit. Those who tend cattle do not take the trouble of keeping an establishment for converting milk into butter. They leave this to another class whose sole profession is the extraction of butter and preparation of curd from milk.	The householders in this district have a simple mode of extracting butter from the cream of milk. The cream is put into a bowl with some water, it is then shaken and whirled by the bare hand.
Chittagong Hill Tracts	......	......	......

BENGAL.

Analytical Statement of the replies from certain Districts of Bengal

	1	2	3
Name of District from which information was obtained.	Is the old Indian churn as given in the sketch appended to Herr Martiny's letter used in the District? If not, what other kind of churns are in use?	Are the *Guddis* of the District of the Aryan or Malayan type?	What is the local vernacular name of the churn used in the District?
Gaya .	The form of churn shown in the illustration of Herr Martiny's letter is that commonly in use in this district.	Aryan . .	*Matmahni* is the most descriptive word, *Mat* meaning the earthen vessel and *Mahni* the stick used for churning. The earthen vessels used are commonly called *Matka* when small and *Bhauri* when big.
Purnea .	The old Indian churn as shown in Herr Martiny's engraving is the only kind in use in this district.	The people that use the churn here are Aryans.	*Ghirni* . .

D. 14 a.

arranged under the headings of Herr Vartiny's *questions*—continued

BENGAL.

	4	5	6
	Is the old Indian churn given in the sketch the churn of the Aryan population? If so, what kind of churn is used by the Malayan population?	It is stated that the Indian churn containing 30 to 35 gallons is used by different people who bring their milk sometimes many miles to the churn. What is the reason for doing so? Why has not every cow-holder his own, of course smaller, churn?	Is there any other primitive churn in use in India, or any other old fashion of making butter; i.e., making butter in a bowl by a whirl without using a string or by shaking (beating) the milk only with the bare hand or shaking it in a skin-bag like the Arabians and the Baluchis?
Gaya.	The churn is that of the Aryans, there are no Malayans known here.	The churns are of all sizes; nearly every one in the country manufactures his own butter, even if only a quarter seer, in a tiny earthen pot stirred with a bit of split stick. The *Gwalás*, however, who keep cows to manufacture butter and curd for sale in the bazar, use churns which will turn out as much as a maund at a time. It is not the custom for persons who have cows to take their milk to another person's churn. Every cow owner has the necessary materials for a churn and makes his own butter	People who have only small quantities to make often prepare the butter by chafing the milk between their hands inside the earthen vessel instead of using a *Mahni* which would be suitable for a small quantity. Butter is not prepared in any of the other ways mentioned, in the villages, but the servants of Europeans and of some residents of big towns prepare it by shaking the milk in a bottle. But this custom is not indigenous.
Purnea.	This churn is used only by the Aryans	Almost every *Gwala*, i.e., a man who keeps cows for selling milk and butter, has his own *Ghurni*, so people have no occasion to bring their milk many miles to the churn	There is no other primitive churn in use in this District, though butter is sometimes made by shaking up milk in a bottle.

Analytical Statement of the replies from certain Districts of Bengal

	1	2	3
Name of District from which information was obtained.	Is the old Indian churn as given in the sketch appended to Herr Martiny's letter used in the District? If not, what other kinds of churns are in use?	Are the *Gualas* of the District of the Aryan or Malayan type?	What is the local vernacular name of the churn used in the District?
Sonthal Parganas (Pakur sub-division)	The old Indian churn as shown in the illustration is in use here	Both Aryans and aborigines are to be found in this district	Higher castes of Bengalis call the churning stick the *Manthan danda* or *Mathni* The lower class of Hindus call it *chatka* In Sonthali the name is *Hondhaini* For large quantities of milk, the earthen vessels used are locally called *jalas*, and smaller earthern pots are called *handis*
Cuttack	Every *Guala* churns his milk in a churn like the sketch appended to Herr Martiny's letter, but the vessel in which the milk is churned is but an earthen pot, a common *kalsi* or *handi* in which a bamboo or wooden whisk (called "*Khna*") is worked round by means of a piece of cloth or rope If the quantity of milk is small the churn is worked between the palms of the hand		

arranged under the headings of Herr Hartley's questions—concluded. BENGAL.

4	5	6	
Is the old Indian churn given in the sketch the churn of the Aryan population? If so, what kind of churn is used by the Malayan population?	It is stated that the Indian churn containing [illegible] gallons was used by a [illegible] people, who being their [illegible] were many [illegible] in the churn. What is the reason for doing so? Why has not every cow keeper his own, of course small, churn?	Is there any other primitive churn in use in India, or any other old fashion of making butter; i.e., making butter in a bowl by a whisk without using a string or by shaking (beating) the milk only with the bare hand or shaking it in a skin bag like the Arabians and the Beluchis?	
...	All owners of cows have their own churn.	When a small quantity for home consumption is required, it is occasionally made by beating the milk only with the bare hand	Sonthal Parganas.
...	Every man has his own churning apparatus in this district	Sometimes milk is shaken in a bottle with the object of producing butter.	Cuttack.

BOMBAY

VIII BOMBAY—The following interesting notes on the subject of the churns in use in the Western Presidency have been communicated by Mr. E. G Ozanne, Survey Commissioner and Director of *Land Records and Agriculture* *It will be observed that Mr. Mollison's* note, forwarded by Mr Ozanne, deals with the practical consideration of the method pursued and the results obtained by the Native churn

Mr. Ozanne writes —

(1) The churn as illustrated in Herr B Martiny's letter No 1 of 28th December 1893 represents the common churn of this Presidency The churns vary in size with th
men) employ large churns
pots The shape and cons
illustrated by Herr B Martiny is used in the Konkan It differs from the illustration only in having no disc on the handle It consists of a piece of bamboo forked out at one end into four segments The beater in common use throughout this Presidency (except in Gujarat) has a wooden handle on which a head piece of iron or hard wood is fitted The head piece is cast or cut into a series of flanges which are well calculated to agitate the contents of the churn thoroughly during the churning process This beater as well as the Konkan beater are adjusted for work in precisely the manner shown in Herr B Martiny's illustration Each is worked by one der to illustrate it I send beater is set in the churn to work it, one on either side

(2) The churns above referred to are used by people of Aryan origin. I can give no information as to the kind of churn used by people of Malayan origin

(3) Every owner of milch cattle has a churn, small or large according to requirements Householders, who do not keep milch cattle, often own a churn and make butter from bought milk The butter is usually made daily, and if the quantity required is small a miniature beater is used and is whirled between the palms of the hands without the aid of a rope

In the households of Europeans, resident in India, butlers make fresh butter each morning by shaking cream mixed with a little water or milk in a bottle or by using an egg beater to agitate the diluted cream in an open bowl

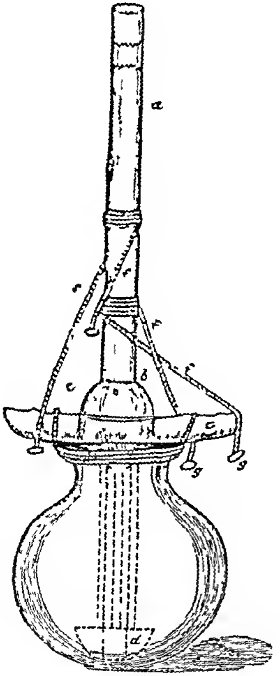
(4) The native churn as a whole has no distinctive vernacular name The essential parts are named as follows in Maráthi, Gujaráti, and Kanarese —

English	Maráthi	Gujaráti	Kanarese
Churn vessel	Máthan	Goli	Majjigi mádo bhándi
Beater	Ravi	Ravai	Kadagolu
Shaft of beater	Dánda	Dándo	Kolu
Head piece of beater	Mathli	Phul	Mandi
Support ropes	Mánjari	Not used	Katto hagga
Rope which works the shaft	Ánsani, bárdi, ravidor	Netara	Kado hagga
Post against which churn is supported	Ghusalkhámb, Tákmadh	Not used	Kado Khamba
Collar on shaft of beater	Not used	Ládvo	Not used
Cross piece which rests upon and is tied to mouth of churn	Not used	Háth	Not used

BOMBAY.

Gujarati Churn

Gujaráti names of parts



a=Dándo.

b=Ládvo.

c=Háth.

d=Phul.

e=Dort.

f=Netara.

g=Adolis.

h=Goli.

to a common or public churn, are not known in Berar. (6) No other churn is in use BERAR

The Deputy Commissioner, Akola, Hyderabad, gives the following information as to the manufacture of the whisk or *Ravi* —The shaft is ordinarily made of *Dhaman* wood, which is tough and elastic For the heads, the best woods are considered to be *Dahi Palas* (Cordia obliqua) and *Butikar* (Elæodendron glaucum) The former is said to thicken the curds and the latter to prevent the churning being spoilt by the glance of a stranger falling upon the operation

X —MYSORE AND COORG —Mr. L Ricketts, Inspector-General of Forests, Mysore has furnished the following memorandum on the subject of the churns in use in that State Perhaps the most interesting part of Mr Ricketts memorandum may be said to be his description of the Malnad churn, which may be described as a joint or *chunga* of bamboo with a piston fitting within, which agitates the milk vertically, on the principle of the churn most generally used in Europe, and not by the rotatory movement of the so-called Aryan churn. In a country that abounds with bamboo, the joints of which lend themselves so readily to this contrivance, it is significant that churns similar to those of Malnad are not more frequently met with The Coorg churn is also extremely curious and is probably an earlier pattern than that in the Malnad The motion is vertical, not rotatory MYSORE.

Description of churns

1 No vessels of any particular material or shape are used for churns in the Mysore State The vessels commonly employed are earthen pots measuring from two to twenty seers or from two imperial quarts or half a gallon to five gallons In some parts of the Malnad or hilly tracts where thick hollow bamboos are available, churns are made of such In more civilized parts of Malnad churns made of tin similar to the churns of bamboo (*chungas* are used The churn is called *Mosaru madikay* in Kanarese

Description of churn-staff

2 The churn-staff is of different kinds It is called *Mollu Kola* or *Kadagolu* in the Kanarese language of this Province The commonest one is a bamboo stick the thick end of which is fastened into a hole in the centre of a whirl which is generally made from the heart wood of white babul (Acacia leucophlœa) The whirl made of this wood is said to produce more butter than that of any other wood The sizes of whirls vary, and are in proportion to the quantity of curds in which they are to be worked To work in pots containing five gallons of curds, churn staffs to which two or three whirls are attached are employed

How large churn staffs are worked

3 Large churn staffs are worked in the following manner —The churn-staff is attached to a pillar or post by two strings the whirl at the bottom of the staff being put into curds in a pot placed against the pillar or post by two strings and turned rapidly round and round by a string worked with both the hands as shown in the accompanying drawings The large churn is used only by those who own a large number of cows, or by those who make large quantities of butter for manufacturing *ghi* which is an article of commerce throughout India it being extensively used by the Natives with meals or for frying different kinds of eatables, currys, etc.

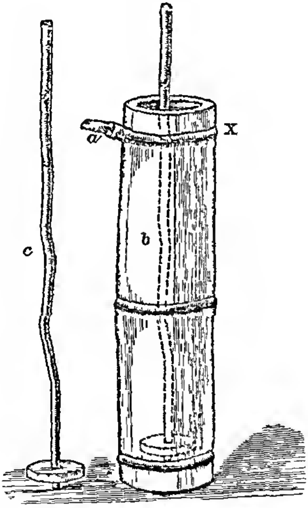
MYSORE

How hand churn staffs are worked.

4 The hand-churn staff is used in the house of almost every Native to make butter or butter-milk from curds under one gallon, and it is worked only with the bare hands in small pots containing curds

Malnad churn and churn staff.

5 In parts of *Malnad*, the churn staff used is not a whirl, but a kind of piston which is worked up and down in the curds in a hollow bamboo reed or a tin vessel made like it The following drawing shows the bamboo and piston churn, an interesting feature of which consists of the small branch left near the mouth as a handle :—



Mysore Churn—
(*a*) Branch left as handle
(*b*) Bamboo, portions of four joints; joint X being left to give strength.
(*c*) Piston

D. 14 a.

MYSORE

Process of making butter

6. Butter is not made from pure milk But milk is well boiled, and when it is lukewarm, a small quantity of butter-milk is put into it to form it into curds from which butter is separated by the operation of the churn-staffs above described

Churn in use in this State is believed to be that of Aryan population

7. It is believed that the churn and the churn-staff in use in the Mysore State are those of the Aryan population It is not known here what kind of churn is used by the Malayan population The Sanscrit name of the churn is *Manthaha*, of the churn-staff, *Mantha-dandaha*, and of the churn-string, *Manthanaha*

The churn and churn-staff are referred to in many Sanscrit works The following Sanscrit stanza is worthy of being quoted —

घोषान्पेनदरदधिविमथ्यमाने घोषालयेपुदधिमंथनतो घोषः ।

दोपात्कनिदिदधतेकुमधकुंभा. प्रियाद्रिपोघरविभीतवसुमभातं ॥

(Oh Lord, Good morning to Thee! The great noise produced by thousands of herdswomen churning curds early in the morning in their churns is so formidable as to break the churns themselves and cleave the air in all directions.)

Cor ... The C ... of Coorg reports —(1) The churn in use ... the milk being worked in it with a ... a cocoanut-shell (2) This churn is ... cular term for churn is *Andé* (4) ... s is unknown (5) The custom of bringing milk from a distance to be churned does not prevail in Coorg Each cow-holder has his own churn No other form of churn is known in this district.

MADRAS.

XI.—MADRAS —The following report on the subject of the churns that are in use in South India has been furnished by Mr. R. C. K. Sabba Row, Sub-Assistant Director of Agriculture —

1 The old Indian churn is used throughout India The churn referred to in the 10th Skandha of Maha Bhagavatam as employed by Krishna's mother is the same as that used by the cowherds now

3 A churn is called in Tamil *Mattu*, in Telegu *Kauvam*, and in Canarese *Kadigolu* The Indian churn is of two kinds One kind consists of an earthenware pot into which is placed a piece of solid bamboo about 4 or 5 feet long, split at one end into 4 strips each about a foot long The strips are bent outwards and held apart from each other by small cross pieces of bamboo inserted between the ends The lower part of the bamboo thus forms a beater 4 inches square The 'beater' is bound all round with strips of palmyra stalk which are smooth and glossy outside This kind of churn is called in Tamil *Aılai Mattu*, in Telugu *Pedda Kauvam*, and in Canarese *Dodda Kadigolu* In the other kind of ch... the beater ... 1 to 2 feet long ... with serrated ... *ttu*, in Telegu ... measures, the *Aılai Mattu* is used As the cost of the churn is hardly six pence, every cow-herd possesses one Nobody takes his milk to a distant place to be

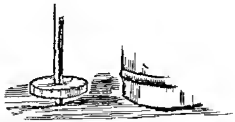
MYSORE

How hand churn staffs ar

4 The hand churn staff is used in the h
make butter or butter-milk from curds und
only with the bare hands in small pots c

Malnad churn ar

5 In parts of *Malnad*, the ch
kind of piston which is worked
bamboo reed or a tin vessel mad
the bamboo and piston churn,
the small branch left near the r



Mysore Churn—
(*a*) Branch left as handle
(*b*) Bamboo, portions of four joints; joint X being le
strength.
(*c*) Piston

THE INDIAN CHURN. A Précis of Official Correspondence.

MADRAS.

be

foot above the other. Sometimes, two bows (sketch on the margin) made of palmyra stalk (with the hollow side turned outward) and a piece of rope string

between its ends are fixed to a pillar of the house, instead of the loops of rope. The shaft is passed through the loops or the bows. The 'beater' of the churn is immersed in the milk. On the shaft of the churn, between the two loops of rope or the bows, a rope is wound, and one end of the rope is taken in each hand. By pulling one end of the rope and then the other alternately the 'beater' is spun. Care is taken that the 'beater' does not come in violent contact with the bottom or the sides of the pot containing the milk. As palmyra stalk is very smooth, there is less friction when its bows are used instead of the loops of rope. After the milk has been churned for about half an hour, a little hot water is added and the churning is resumed for about half an hour more. The particles of butter will then have risen to the surface. For the purpose of collecting the butter the milk is then beaten with the hand. If a cow-herd wishes to sell his milk as curds, he skims off the cream and churns it separately. If he wishes to sell his milk as buttermilk, the whole of the milk is churned. As a rule, butter is made from buffaloes' milk, to be converted into *ghí* and only to a small extent from cows' milk. A cow-buffalo yields, on the average, 6 ounces of butter per Madras measure of milk (100 cubic inches). A cow yields only about 3 to 3½ ounces per measure.

If the quantity of milk to be churned be more than 1 Madras measure and less than 5 measures, a *Kai Mattu* of a large size (with a shaft 3 feet long) is used in the same way as the *NilaiMattu* above described. If the quantity be a measure or less, a small *Kai Mattu* with a shaft only about a foot or 1½ feet long is used. The disc being immersed in the milk,

thick mass of buttermilk.

BURMA.

...the Department of Land
...de in several districts
...her than that described
...e among the Burmans

ing purposes.

CALCUTTA;
July 30th, 1895.

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

The objects of this publication (as already stated) are to gradually develop and perfect our knowledge of Indian Agricultural and Economic questions. Contributions or corrections and additions will therefore be most welcome.

In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series Those of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

This sheet and the title-page may be removed when the subject-matter is filed in its proper place, according to the letter and number shown at the bottom of each page.

THE

AGRICULTURAL LEDGER.

1895—No. 24.

OXEN.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V., O. 551–94.*]

THE CATTLE OF MYSORE:

Note by A. KRISTNAMANGAR, B.A., *and* VETERINARY CAPTAIN
H. T. PEASE, F.Z.S.

Other PAPERS that may be consulted:

Agricultural Ledger Nos. 19 of 1893; 14 of 1894; 7; 10; 12; 19 and 22 of 1895.

CALCUTTA:
OFFICE OF THE SUPERINTENDENT, GOVERNMENT PRINTING, INDIA.
1896.

The objects of THE AGRICULTURAL LEDGER are —

(1) To provide information connected with agriculture or with economic produc in a form which will admit of its ready transfer to ledgers,

(2) To secure the maintenance of uniform ledgers (on the plan of the Dictionary in all offices concerned in agricultural subjects throughout India, so tha references to ledger entries made in any report or publication may be readily utilised in all offices where ledgers are kept,

(3) To admit of the circulation, in convenient form, of information on any subject connected with agriculture or economic products to officials or other persons interested therein;

(4) To secure a connection between all papers of interest published on subjects relating to economic products and the official Dictionary of Economic Products With this object the information published in these ledgers will uniformly be given under the name and number of the Dictionary article which they more especially amplify. When the subject dealt with has not been taken up in the Dictionary, the position it very possibly would occupy in future issues of that work will be assigned to it.

[V]eterinary Series, No. 16]

THE AGRICULTURAL LEDGER.

1895—No. 24.

OXEN.

[*Dictionary of Economic Products, Vol. V*, O 551—94]

THE CATTLE OF MYSORE.

[N]ote by A. KRISTNAMANGAR, B.A., and VETERINARY CAPTAIN H. T. PEASE, F.Z.S.

INTRODUCTORY.

History.

Mysore has enjoyed, from a very early period, a just renown for her superior breed of cattle. The generally mild and salubrious climate of the plateau with an extensive pasture on which cultivation had not made much inroad favored cattle breeding, and attracted Gollas and other nomadic tribes from the north who brought with them excellent breeds which being established for generations in the country and mixing with the indigenous cattle have improved them. Besides as the rulers of the Province took an active interest in the matter, maintaining great herds of breeding cattle and managing them properly, thus affording a good example to the people generally. The Royal herds must naturally have influenced cattle breeding greatly in the parts where their grazing grounds lay as, no doubt, the village cattle got the services of the bull very often. The people could scarcely fail to profit by the lessons in breeding to be learnt from the Amrut Mahal establishment and were brought to recognise the importance of selection and segregation. Thus cattle-breeding flourished in the tract and good breeds resulted. Cattle constitute the life and soul of agriculture. They perform the whole of the agricultural draught work. The substance of a ryot is usually rated by the number he owns and of the ploughs he works. Cattle are intimately associated in the domestic incidents of the people. The present of a cow with a few acres of land to the bridegroom is a notable part of the marriage ceremonial. The present of a cow and land is also a part of the Brahmanical obsequies. So useful are cattle in contributing to the existence and comfort of man, and so highly are they esteemed that it is no wonder that in primitive times, and even to a certain extent at present, the people should venerate them as objects of worship. [illegible]

OXEN	*The Cattle of*

INTRODUCTORY.

is pursued nearly all over the Province, except in the Malnad on the western parts of Mysore, which is covered with dense forests created by heavy and continuous rain fatal to cattle. Every raiyat almost is a cattle-breeder, and every village a cattle mart besides the great annual fairs

Cattle fairs

These cattle fairs are an interesting feature, and the fact that they flourish all over the country is a proof that they satisfy a real want Numbers of them are held at different times in different parts of the Province, and they constitute the centres from which the whole country is supplied with agricultural and draught cattle Even the districts of the neighbouring British provinces depend in a measure on them for their cattle supply The fairs are generally the ostensible accompaniment of some great religious festival They follow each other in convenient succession, so that cattle not sold in one may be taken to another The great cattle fair at Tiruvanamalai in the South Arcot District in the Madras Presidency is supplied mostly with Mysore cattle, or kindred breeds from the neighbouring taluks of the Salem District, which, it is understood, find their way even into Ceylon A list of the most important fairs, with dates and the description of breeds sold, will be found on page 50 A brief account of one of the largest of them held in this Province may not be uninteresting

A Mysore Cattle fair described

The scene of this annual fair is near the "Ghat,' through which the Bangalore-Hindupur Railway debouches from the Dodbalapur tableland into the comparatively plain country beyond The locality seems to have been selected on account of the large picketing ground it affords, of the supply of firewood which the scrub jungle offers, and the good water supply furnished by a rivulet that skirts the spot For some miles around it there are very few inhabited villages, and this circumstance ensures plenty of room for the cattle to roam about. The fair is looked forward to with eagerness not only by those who have to buy and sell cattle but also by pilgrims and sight seers by whom it is crowded *"Dallals"* or brokers in effecting transactions are an important institution here For days together, strings of cattle and carts laden with provision for man and beast may be seen wending their way by almost impracticable cart tracks which, winding round hillocks and through valleys, lead up to this, for the time, great centre of activity. The spot, desolate all the year round except at this season, presents an animated scene An area of about two square miles is crammed with cattle, carts and men On rough computation, it is estimated that 10 000 carts and 30,000 bullocks are collected at the fair One remarkable circumstance is the entire absence of cows Bulls of various breeds, ages, and colors, castrated and entire are gathered there Calves under one year are collected in a well known corner The predominant breed offered for sale is the *Belladana*, or *Mahadeswara betta* breed. There are exhibited bullocks, suited for various purposes, for the plough, for heavy carts and light draught, and a few of these are priced as high as R700 the pair There are large-sized bulls fattened up and

in excellent condition, with jingling bells round their necks and caparisoned with cloths of various and picturesque colors and designs, on which are wrought curious and fantastic figures. During the first days of the gathering the prices rule high, and few transactions are effected except in the case of cattle destined for butcher's meat. In former times raiyats were superstitiously averse to selling cattle for slaughter, but ideas have, in this respect, undergone a change, and hundreds of agents may be seen successfully bargaining for the inferior sort of cattle intended for the slaughter house. During this period of apparent inactivity, many a sidelong glance is cast at the desired purchase, and brokers are busily engaged in testing the pulse of demand and the number of cattle offered for sale. Towards the latter half of the week during which the fair lasts, transactions assume a brisk turn and thousands of cattle and many thousands of rupees change hands. The immense gathering then begins gradually to disperse.

INTRODUCTORY.

A Mysore Cattle fair described.

BREEDING

On Breeds of Cattle in Mysore.

Two descriptions of cattle exist side by side in Mysore, each serving its own particular purpose. The first and by far the most numerous of these is known as "*Nadudana*" are village cattle, these of small size, compact frame and various colors. Every village in the Province teems with them. They constitute the bulk of the agricultural stock, and are the main source of dairy produce. The second is termed "*Doddadana*" (big cattle) and consists of the less numerous, but more efficient and valuable kinds of more uniform size and color; they are more often employed in conveying the traffic of the country than in agriculture, and are largely sold in cattle markets. The term "*Doddadana*" embraces the *Amrut Mahal, Hallikar, Chittaldroog, Mahadeswara betta,* and their kindred breeds. Cattle of this description are owned only by well-to-do raiyats and breeders. Besides the professional breeder, every raiyat who has a little capital adds to his agricultural occupation that of rearing a few head of cattle. There is a convenient division of labor in this matter. There are parties who keep herds of cows and bulls for breeding purposes, mostly in the vicinity of grazing hills and lowland forests. Calves of one or two years are bought from them by raiyats, who rear them with much care for two or three years, and send them for sale at the cattle fairs.

The whole breeding operations of the country are carried on by means of three descriptions of bulls:—

- (*a*) choice bulls of the "*Doddadana*" breeds, kept in villages and home fed, allowed to graze on village crops or kept with the herds in the jungle pastures, these may be styled special superior breeding bulls;
- (*b*) calves of "*Doddadana*" bought when young and reared in villages destined for agriculture or sale after castration, but employed as sires meanwhile, these may be styled casual good breeding bulls; they are moderately good, though

OXEN	The Cattle of

BREEDING

inferior to the first named for breeding, and, being permitted to cover before castration, make less efficient agricultural and draught cattle;

(c) the numerous small-sized and more or less ill-shaped young males of "*Nadudana*," herding with the village cattle and breeding them down lower and lower, these may be styled "*Nadu*" bulls.

Nadudana or village cattle

"*Nadudana*" or village cattle are left entirely to themselves without any control and without any of those artificial restrictions by which alone a breed can be saved from deterioration when living under the artificial conditions in which they are placed by domestication. Seldom is any selection of breeding cows and bulls made with reference to their fitness for producing a vigorous and healthy progeny The slaughter of cows is rare, and any cow, however deformed or diminutive, is allowed to breed Inferior and defective bulls are generally uncastrated. The common practice of driving all the village cattle in one herd to graze leads to indiscriminate breeding Most village cows are from these various causes so small and of such little value that the owners do not think it worth their while to get superior bulls to serve them These bulls are not plentiful and, when available, have to be paid for service, which payment the owner of a puny cow naturally grudges. In many instances, before the owner makes up his mind, the village bull forestalls him Such are some of the difficulties which lie in the way of getting village cows served by good bulls But the absence of such bulls is the prime cause of the deterioration of the breed from generation to generation The recent order of Government for supplying *Amrut Mahal* bulls to taluks at the cost of local funds, is a move in the right direction The difference in the condition of "*Nadudana*" in localities where inferior local bulls have been replaced by superior ones, is very striking In some parts of the Bangalore and Kolar Districts, it is a common practice for two or more villages to join and subscribe for the purchase of a superior bull, usually one of the *Mahadeswara betta* breed is chosen The bull is carefully selected and purchased when young It is the common property of the villagers, and being allowed to graze on the crops in private fields, keeps in excellent condition Such bulls accompany the herd during the day, but being accustomed to graze on the crops, seldom pay heed to the poor village common In the hot season such bulls are fed on straw by any one of the common owners It is not unusual for some well to do men, from motives of charity, it being considered a meritorious act to purchase similar breeding bulls at their own cost and let them free These bulls are also allowed free grazing by the villagers. They pay frequent visits to the neighbouring villages and attend to cows in season, keeping off inferior "*Nadudana*" bulls. In the French Rocks Sub Division of the Mysore District and in the adjoining parts of the Tumkur District special bulls of the *Hallikar* breed are kept home-fed for breeding, a fee of from half to two rupees being charged for each cow served, higher

BREEDING.

fees being demanded for *Karadahalli Gujmavu* bulls In the Arsikere, Tarikere, Kadur, and Channagiri Taluks, bulls of the *Amrut Mahal* blood are often met with, while in the southern and eastern parts of Chitaldroog, bulls of the *Chitaldroog* breed are found largely distributed in the villages In other parts of the Province no special bulls are maintained, the breeding being mostly carried on by means of casual bulls of the *Mahadeswara betta* or other "*Doddadana*" variety.

Doddadana breeds

Great care and attention are bestowed on the selection of animals for breeding the "*Doddadana*" The conditions under which they are reared afford facilities for the regulation of breeding Cows of this breed are sometimes kept in villages, home fed and under shelter, in which case superior bulls or at least casual good breeding bulls are invariably secured to serve them Herds of them are also kept in "*roppas,*" or open kraals fenced with thorn, generally at some distance from villages, but sometimes near them, they always graze separate from village cattle and, as care is taken to exclude inferior village bulls, they are not liable to be bulled by them Each herd has its own special bull, sometimes selected in the same herd, but more often to prevent in and in-breeding from some other herd As the bull grows old and deficient in vigour, a young one is selected and kept in the herd to take its place There are thus, in the majority of the herds, two bulls, one old and the other young The young one in many cases acts only the part of a teaser. No sooner does it perceive that a cow is in heat than it approaches and keeps constantly attending on her The cow for a time moves about in order to get free from the young bull, which, however, being very active, persists in following her until at last the cow seeks the protection of the older bull which the young one dare not approach and which then serves the cow This habit is also observable in the *Amrut Mahal* herds, where two bulls are kept generally for a fixed number of cows. In some herds of the "*Doddadana,*" a limited number of cows of the village breed is sometimes allowed to mix. Inferior cows are also occasionally introduced on payment, and kept in the herd for the purpose of sharing the advantage of being served by a good bull On the banks of the river Cauvery in the Kankanhalli Taluk, some owners of the *Mahadeswara betta* herds, having lost considerable numbers of their stock during the prolonged drought of 1891-92, and wishing to replenish their loss, purchased a number of cheap village cows and mixed them with the remnants of the old stock, having their own pure-bred bull This is a cheap way of forming new herds, but it takes ten to twenty years to raise the standard of the progeny to the larger size and value of the pure-bred specimens. It is said that the progeny second in descent generally attains all the qualities of the pure breed, or even if traces of maternal defects should linger in it, an animal third in descent, to a certainty, attains that standard of size shape color and efficiency A transformation, therefore, from the village to "*Betta*" or any other breed, if it is

Doddada a or big cattle.

OXEN	The Cattle of

BREEDING

inferior to the first named for breeding, and, being permitted to cover before castration, make less efficient agricultural and draught cattle;

(c) the numerous small-sized and more or less ill shaped young males of "*Nadudana*," herding with the village cattle and breeding them down lower and lower, these may be styled "*Nadu*" bulls.

Nadudana or village cattle

"*Nadudana*" or village cattle are left entirely to themselves without any control and without any of those artificial restrictions by which alone a breed can be saved from deterioration when living under the artificial conditions in which they are placed by domestication. Seldom is any selection of breeding cows and bulls made with reference to their fitness for producing a vigorous and healthy progeny The slaughter of cows is rare, and any cow, however deformed or diminutive, is allowed to breed Inferior and defective bulls are generally uncastrated. The common practice of driving all the village cattle in one herd to graze leads to indiscriminate breeding Most village cows are from these various causes so small and of such little value that the owners do not think it worth their while to get superior bulls to serve them. These bulls are not plentiful and, when available, have to be paid for service, which payment the owner of a puny cow naturally grudges. In many instances before the owner makes up his mind, the village bull forestalls him Such are some of the difficulties which lie in the way of getting village cows served by good bulls But the absence of such bulls is the prime cause of the deterioration of the breed from generation to generation The recent order of Government for supplying *Amrut Mahal* bulls to taluks at the cost of local funds, is a move in the right direction The difference in the condition of "*Nadudana*" in localities where inferior local bulls have been replaced by superior ones, is very striking In some parts of the Bangalore and Kolar Districts, it is a common practice for two or more villages to join and subscribe for the purchase of a superior bull, usually one of the *Mahadeswara betta* breed is chosen The bull is carefully selected and purchased when young It is the common property of the villagers, and being allowed to graze on the crops in private fields keeps in excellent condition Such bulls accompany the herd during the day, but being accustomed to graze on the crops, seldom pay heed to the poor village common In the hot season such bulls are fed on straw by any one of the common owners It is not unusual for some well to do men, from motives of charity, it being considered a meritorious act, to purchase similar breeding bulls at their own cost and let them free These bulls are also allowed free grazing by the villagers. They pay frequent visits to the neighbouring villages and attend to cows in season, keeping off inferior "*Nadudana*" bulls. In the French Rocks Sub Division of the Mysore District and in the adjoining parts of the Tumkur District special bulls of the *Hallikar* breed are kept home-fed for breeding, a fee of from half to two rupees being charged for each cow served, higher

Mysore (*A Kristnamangar and H T Pease*) | OXEN

fees being demanded for *Karadahalli Gujmavu* bulls In the Arsikere, Tarikere, Kadur, and Channagiri Taluks, bulls of the *Amrut Mahal* blood are often met with, while in the southern and eastern parts of Chitaldroog, bulls of the *Chitaldroog* breed are found largely distributed in the villages In other parts of the Province no special bulls are maintained, the breeding being mostly carried on by means of casual bulls of the *Mahadeswara betta* or other "*Doddadana*" variety.

BREEDING.

Great care and attention are bestowed on the selection of animals for breeding the "*Doddadana*" The conditions under which they are reared afford facilities for the regulation of breeding Cows of this breed are sometimes kept in villages, home fed and under shelter, in which case superior bulls or at least casual good breeding bulls are invariably secured to serve them Herds of them are also kept in "*roppas*," or open kraals fenced with thorn, generally at some distance from villages, but sometimes near them, they always graze separate from village cattle and, as care is taken to exclude inferior village bulls, they are not liable to be bulled by them Each herd has its own special bull, sometimes selected in the same herd, but more often to prevent in and in breeding from some other herd As the bull grows old and deficient in vigour, a young one is selected and kept in the herd to take its place There are thus, in the majority of the herds, two bulls, one old and the other young The young one in many cases acts only the part of a teaser No sooner does it perceive that a cow is in heat than it approaches and keeps constantly attending on her The cow for a time moves about in order to get free from the young bull which, however, being very active, persists in following her until at last the cow seeks the protection of the older bull which the young one dare not approach and which then serves the cow This habit is also observable in the *Amrut Mahal* herds where two bulls are kept generally for a fixed number of cows In some herds of the "*Doddadana,*" a limited number of cows of the village breed is sometimes allowed to mix Inferior cows are also occasionally introduced on payment, and kept in the herd for the purpose of sharing the advantage of being served by a good bull On the banks of the river Cauvery in the Kankanhalli Taluk, some owners of the *Mahadeswara betta* herds, having lost considerable numbers of their stock during the prolonged drought of 1891-92, and wishing to replenish their loss, purchased a number of cheap village cows and mixed them with the remnants of the old stock, having their own pure-bred bull This is a cheap way of forming new herds, but it takes ten to twenty years to raise the standard of the progeny to the larger size and value of the pure-bred specimens It is said that the progeny second in descent generally attains all the qualities of the pure breed, or even if traces of maternal defects should linger in it an animal third in descent, to a certainty, attains that standard of size shape color and efficiency A transformation, therefore, from the village to "*Betta*" or any other breed, if it is

Doddadana breeds

Doddadana or big cattle.

BREEDING

wished, may in this manner be completed for all practical purposes The following hypothetical genealogical table illustrates what is here asserted —

Breeding as practised to improve stock

"Nadu" cow + pure *Mahadeswara betta* bull
|
Cow first in descent + pure *Mahadeswara betta* bull
|
Cow second in descent (said to possess all the qualities of the father's breed) + pure *Mahadeswara betta* bull
|
Cow or bull apparently the same as the other pure bred animals of *Mahadeswara betta*

In selecting animals for breeding, breeders do not seem to aim at developing in the offspring any particular aptitude or special fitness for draught, for carrying pack load, for slaughter, or for dairy produce The only aim is to produce size, strength, and shape, good limbs and attractive color, which are specially prized in the markets where draught bullocks are in demand The following are considered good points in a breeding bull, and are more or less looked for by all careful breeders —

Good points in a bull

(1) length
(2) good height, 48 to 50 inches,
(3) long and tapering head with a narrow and prominent forehead;
(4) small, but prominent and bright eyes,
(5) small and erect ears,
(6) thin, fairly long, and gracefully set horns, the difference between their thickness at the base and at the end being small;
(7) strong and fairly long neck with a small well shaped hump,
(8) thin and short dewlap,
(9) broad and full chest,
(10) well formed and strong shoulders and hind quarters,
(11) strong and well rounded ribs,
(12) level back and broad loins,
(13) narrow flanks,
(14) a level croup, an abruptly falling croup being condemned,
(15) thin short whip-like tail reaching down to or very little below the point of the hock joint,
(16) a well projecting anus so that the ejected dung may fall clear off the body, it should not be situated in a niche like hollow as in cows and old animals,
(17) a sheath having little or no pendulous growth,
(18) legs of medium length and well proportioned, having strong and fairly thick bones, and moving together in perfect rhythm and not turned sideways or brushing against each other,

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BREEDING.

(19) short fetlocks and hard small hoofs with equal halves with a very narrow cleft between; a long shank is considered a weakness,
(20) black skin, horns, muzzle, and hoofs,
(21) thin skin covered with short and soft hair, blue and iron-grey colors are preferred,
(22) a compact body, free from all unnecessary pendulous growths,
(23) the animal should be sound in every way, symmetrical, of good temper and pure breed, and free from hereditary disease.

The above points have reference both to strength and beauty It is of course difficult to find all of them present in any specimen To the selection of the cow, no special care or attention is bestowed, but the bull, considering the number of animals it is likely to influence, is most carefully selected. The main points looked for in cows are good size and length, shapely head and horns, broad hips and loins and good whole color.

Castration

Castration and segregation are the two means by which inferior bulls are debarred from breeding The cows of the "*Doddadana*" cattle are valuable, being capable of producing high priced animals. Contamination of them by inferior blood even though of the same herd, is carefully prevented Herds are therefore not only kept away from village bulls, but are also annually weeded of all their own young males before these develop any breeding propensity The bull calves, for which there is always a keen demand, including sometimes even calves four months old, are sold to purchasers who take them away and rear them Such as are not so sold are either castrated early and kept in the herds, or more often taken home and trained for work In some villages where good bulls are available all the malformed and small ones are either castrated or separated from the general herd of cows, in which latter case they are kept with the working bullocks and like them home-fed. The latter method has the advantage that careful attention is paid to the hand feeding of calves Segregation is more often resorted to than is castration, for, as almost all male stock, whatever their shape and size, are ultimately destined for agriculture, their castration can by this means be delayed till they have six teeth In some very rare instances bulls have a gunny bag sack tied up so as to enclose the sheath and render covering impossible

Segregation.

Immature animals not always prevented from breeding

The importance of preventing immature animals from breeding and of delaying breeding till the animals attain mature years are known and appreciated, but they find no practical application in the rearing of village cattle Even as regards the *Doddadana*,' they are not invariably observed in the case of cows in herds, though when valuable cows are kept in houses the owners prevent them from breeding till they are of adult age, notwithstanding their coming in season meanwhile. In the *Amrut Mahal* Department care is taken to separate and leave behind all young heifers when the herds are driven to tracts where the conditions of soil and fodder would induce their coming prematurely into season. In the case of male animals

OXEN.	The Cattle of

BREEDING.

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OXEN	The Cattle of

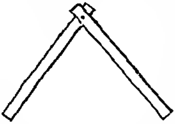
CASTRATION

It must however be stated that other authorities are directly opposed to Professor Wallace's opinion on this point, and that in Harriana, where the best cattle in Northern India are bred, the operation is carried out early by the people

Season best adapted for the purpose

The period of the year considered most suitable for castration is the season of plenty, from October to February, when the weather is bracing and cool and when there is an abundance of fodder and water available The time for operation is generally in the cool of the morning

There are three different methods by which castration is effected, 1stly, by crushing the testicle, or the spermatic cord, or both, 2ndly, by causing a wound at a point between the two lobes of the scrotal sack and allowing maggots to form and eat up the glands and then healing the wound; 3rdly and lastly, by cutting open the sack and removing the testicles Except under the second method the animals are invariably thrown on some soft ground in the same manner as when being shod When adopting the first method the most prevalent practice is to pull the scrotum well out, to push one of the testicles up and secure the other between two short and stout sticks which, tied at one end and free at the other, as shown in the margin, can be closed or drawn together. When the testicle is thus held firmly, as if in a vice, its apex is turned up by gently turning the sticks, and it is pressed by the hand vigorously down against the sticks, till all the hard tissue is broken up and reduced to a pulpy mass The second testicle is then similarly treated To ensure the success of the operation particular care is taken to apply the pressure on the apex and vertically downwards In fact success may be said to be dependent in great measure on skilful manipulation The operation should not be performed when the animal is low in condition In this operation great care should be taken that no pressure is accidentally put upon the rudimentary teats and their immediate vicinity Any inattention to this precaution results, it is said, in instantaneous death, or in tetanus setting in, eventually ending in death even if life should be prolonged for a day or two Another device occasionally adopted is to tie a string tightly round the scrotal sac, just above the glands and to strike them with a hammer or a stout stick, so as to crush them



Different modes practised

There is another mode by which the spermatic cord is maimed and crushed, *viz*, by placing the cord (at a safe distance from the rudimentary teats) on a thin iron rod and giving it one or more [illegible]lden blows with a small hammer This method, though it leaves t[illegible] undisturbed, ensures their withering away In the course of [illegible] In some localities the operation of crushing the spermati[illegible] to in addition to crushing the testicles to ensure thoroug[illegible]

There is again another manner in which castratio[illegible] effect

CASTRATION.

ed. A string is tied tightly round the cord just above the testicles and is pulled forcibly with a strong jerk, crushing and disorganising the cord and, partially, also the testicles.

The second of the two methods above enumerated, namely, that of destroying the glands by maggots, is happily limited in extent. The maggots fall off about the eighth day and a second set is allowed to form. When at the end of ten or twelve days the testicles are completely destroyed, the maggots are got rid of by the application of the milk of the banyan tree and turmeric powder to the wound. Other stuffs, such as kerosine oil, or slaked lime and green tobacco leaves ground together, are also used to remove the maggots.

The third of the three systems already referred to is in vogue in the *Amrut Mahal* Department and among those breeders who follow its example in improved methods of breeding. In that Department the slit is made with a knife; common breeders, however, sometimes use a piece of quartz with a sharp edge for making the opening. When the testicles are thus got at, a ligature of fine thread is applied to the arteries to prevent bleeding, and they are removed Some dry cow-dung powder is placed in the sac and the wound is either stitched or tied up It heals in about twenty days, cow dung powder being said to be a very good antiseptic. Tar or "neem" oil is sometimes applied externally to prevent maggots from forming. In some of rare instances one of the testicles is absent not having descended into the scrotal sac It has therefore to be brought down by expert manipulation before the operation can be completed

Preparatory treatment.

The night previous to castration the animal is given about 4 ounces of gingelly oil or oil of *Guizotia abyssynica* with two or three eggs; and after the close of the operation on the following morning, a drink of two or three hornfuls of buttermilk mixed with onions and a small quantity of turmeric pounded together is administered In some localities two hornfuls of a mixture of cow's milk, *ghi* and asafœtida is given immediately after castration, and is followed for a week or so by a drench made from the juice of the leaves of heart-seed mixed with buttermilk and given every morning. Various means are at the same time employed for reducing the inflammation of the scrotum including the swimming of the animal every morning for a week from the second or third day after castration. Cold water is dashed on the parts; the animal is bathed in cold water, and other applications are not unusual, such as cow-dung or the juice of the leaves of "*Kachi*" or of Datura (thorn apple) The animal has high fever for a day or two after castration and does not feed till it subsides It takes from twenty days to a month to recover from the operation. Various kinds of nourishing and fattening food are given for a more or less lengthened period afterwards. When the castrated animal is not valuable or when the owner has a number to attend to, it is generally given nothing, but some straw and green fodder.

OXEN	The Cattle of

MANAGEMENT.

MANAGEMENT OF CATTLE.

Cattle bred in great numbers, both *"Doddadanas"* and *"Nadudanas"* are more or less neglected as regards protection from the weather They are grazed during the day and are driven for the night into open enclosures exposed in bad weather to rain, wind, and dew. The droppings are seldom removed from the enclosure except near cultivated lands where they are of value as manure Young calves are sheltered in sheds provided for the men tending the herds. This treatment has, to a certain extent, the effect of hardening the stock and improving the breed as it kills off the weaker animals In the dry months their lot is more comfortable The accumulated droppings dry up and afford a sort of soft powder bedding. Careful breeders select dry hard ground for *"roppas"* and change them from time to time Home-bred cattle and those kept for draught are kept in sheds or in the houses of the owners It is not unusual to find a rayiat and his family sleeping in the same apartment with his oxen In the open *"roppas"* cattle often fight and horn each other badly Feeding troughs made of stone slabs or planks are often provided in houses for economising the fodder Well to-do and intelligent raiyats have their sheds flagged with stone slabs inclining towards a tub or pot for catching the urine In some parts the dung is collected, dried and spread under the cattle for bedding, and absorbing the urine becomes valuable manure The conditions of the tract known as the Manad are peculiar and are very unfavorable to cattle These tracts get a rainfall varying from 60 to 160 inches a year. The consequent excessive moisture is prejudicial to the health of the cattle, while the wet or rice cultivation there unduly taxes their vitality One usage to which cattle are subjected is of all other conditions most unfavourable to their well being *"Sipari"* cultivation, which constitutes the chief wealth of the Malnad requires heavy manuring Leaf manure has, by experience, been found to be indispensable Raiyats in the Malnad spread a layer of green leaves in the cattle shed and tether their cattle thereon, so as to receive the droppings From day to day additional layers of leaves are spread, this goes on for a week or so till the whole mass of leaves soaked in and mixed with cattle urine and manure is removed and deposited in the manure pit This goes on through the greater portion of the year With work in excessive wet and rain during the day, and this treatment in their resting place at night, the cattle sustain such wear and tear and mortality, that one of the most costly and frequently recurring items of the Malnad raiyats expenses is the purchase of bullocks Added to this is the very coarse and innutritious pasturage of these dense forest regions where the grass seems to be deprived of its usual nourishing quality by the excessive rainfall The cattle of the *Aacha Gowlies*, which will be referred to further on, are an apparent exception to this rule, for they thrive in the Malnad, it has, however, to be observed that the bulk of their cattle consists of buffaloes which delight in moisture and can subsist on coarse grass

Manner of obtaining leaf manure injurious to the cattle

Mysore (*A Kristnamangar and H T, Pease.*) | OXEN.

MANAGEMENT Kacha Gowlies.

It may not be uninteresting to give here a brief account of "*Kacha Gowlies,*" a nomadic tribe owning herds of cattle, who have in recent years immigrated into the Malnad parts of Mysore They speak KANARESE and are hardly able to converse in MAHRATTA They encamp in jungles seldom visiting villages or towns, except for the purpose of procuring provisions or selling their dairy produce They shift from jungle to jungle. They are primitive in their habits and live in low huts or other temporary structures. Their means of living is derived from their cattle, chiefly buffaloes Their principal dairy produce is butter, which commands a ready sale. They have introduced a peculiar breed of cows and buffaloes from Goa and the Konkan country They take great care of their cattle which are healthy and give plenty of milk, unlike the generality of the Malnad cattle. Owing to their extreme simplicity, and to the fact of their possessing some money, they are occasionally robbed by professional thieves and dacoits and spoiled by petty officials, but they are protected by the Forest Department, for, though they do some damage, yet they abide by rules and doubtless in time their herds will increase to the great benefit of a considerable tract of country where other cattle do not thrive at all

Cattle are seldom provided with "*jhools*" except valuable cart bullocks which are provided with coverings of gunny bags, or coarse home-made "kumblies" or cloths Where mosquitoes abound, it is usual to smoke cattle sheds at night as a means of keeping them off

Occasional abnormal growth when green fodder is abundant.

When green fodder is plentiful cattle sometimes suffer from an abnormal papillary growth on their tongue, which prevents them from feeding and drinking as usual Various remedies are employed to remove this growth One of the commonest means is to rub the tongue briskly with a mixture of common salt and turmeric powder.

Remedies described.

A thick band of straw enclosing a quantity of common salt is sometimes placed in the mouth of the animal and the ends of it taken up and tied behind the horns. The salt melting with the saliva causes the animal to work the tongue and the friction thus induced brings on relief or cure. Another method is to spread a thin layer of powdered common salt on the rough surface of a flat stone and to induce the animal to lick it. Cattle that have an opportunity and are in the habit of licking earth salt are not liable to such abnormal growth on the tongue and even if they do get it, are quickly cured Salt is not usually given in the hot season, as it is supposed to reduce condition It is given only to working bullocks and valuable animals kept in the villages When pasture is plentiful it is usual in some parts of Mysore to give the working bullocks and valuable bulls a drench of warm *ragi conji* mixed with about ½ of a seer of melted fat either of the pig or goat, or when that cannot be procured, of *ghi* On the day they are given this drench they are allowed only a small draught of water, and that late in the day The animals thus treated are rested for a period of not less than a week This treatment is adopted to improve the condition of the cattle. A mixture of tamarind *jaggery* and onions beaten and mixed

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Occasional abnormal growth when green fodder is abundant

Remedies described.

When green fodder is plentiful cattle sometimes suffer from an abnormal papillary growth on their tongue, which prevents them from feeding and drinking as usual Various remedies are employed to remove this growth One of the commonest means is to rub the tongue briskly with a mixture of common salt and turmeric powder. A thick band of straw enclosing a quantity of common salt is sometimes placed in the mouth of the animal and the ends of it taken up and tied behind the horns The salt melting with the saliva causes the animal to work the tongue, and the friction thus induced brings on relief or cure. Another method is to spread a thin layer of powdered common salt on the rough surface of a flat stone and to induce the animal to lick it. Cattle that have an opportunity and are in the habit of licking earth salt are not liable to such abnormal growth on the tongue and even if they do get it, are quickly cured Salt is not usually given in the hot season, as it is supposed to reduce condition It is given only to working bullocks and valuable animals kept in the villages When pasture is plentiful it is usual in some parts of Mysore to give the working bullocks and valuable bulls a drench of warm *ragi conji* mixed with about $\frac{1}{8}$ of a seer of melted fat either of the pig or goat, or when that cannot be procured, of *ghi* On the day they are given this drench they are allowed only a small draught of water, and that late in the day The animals thus treated are rested for a period of not less than a week This treatment is adopted to improve the condition of the cattle A mixture of tamarind, *jaggery* and onions beaten and mixed

OXEN,	The Cattle of

MANAGEMENT

together, is given to relieve and invigorate animals after protracted and hard work, especially on dusty roads Cattle are provided with nose-strings The string is usually put on when the animal is a year and a half or two years old It is passed through a hole made in the septum of the nose Careful raiyats and cartmen rub down their working cattle every evening with a bag of cocoanut coir net used as a glove, or with a section of a mature dry fruit of Luffa acutangula Herds brought up in a semi wild state are not washed. Domesticated animals are occasionally washed Attentive milkmen always wash their cows. Cattle ploughing in slushy paddy-fields are washed either partially or wholly upon being unyoked Cattle are used for draught of various kinds In connection with agriculture, besides ploughing and the like, they are also employed in treading on the thrashing floors either for tamping the ground or for thrashing the corn They are also used as pack animals for carrying merchandise in places where roads are bad or absent The usual hours of work in agricultural operations are from 6 to 11-30 A M, and again from 3 to 6 P M, in dry cultivation, and only from 6 to 11-30 A M in wet lands If the weather be very hot work is commenced earlier and the midday rest is more prolonged In parts of Mysore cattle are worked from 9 A M to 4 P M, without the intervening rest In most parts of the Province Monday is observed as a holiday for cattle, and they are not yoked for any work within the limits of the village, and when any urgent work is to be done on this day people sometimes make use of buffaloes Bullocks are not worked before the fourth year It takes a year to train them, during which period they do but light work After the 5th year, they turn out full work till about the 12th year, when decline generally sets in From about the 17th year they cease to be capable of any work and gradually sink, dying about the 20th year Within a limit of five years their longevity varies according to the vitality of the breed and the nature of the work on which they are employed Cart bullocks generally die earlier than other agricultural stock *Amrut Mahal* bulls live and work longer than other breeds in Mysore Cows are only worked by the poorest classes who cannot afford to buy bullocks When cattle have to work in a standing crop or when treading corn they are muzzled with coir-bags or split bamboo wicker baskets shaped to fit Calves inclined to lick and swallow earth are also provided with muzzles Village cattle which are in the habit of straying have a short stick suspended from their necks which getting entangled between the forelegs hampers their movements They are sometimes also hamshackled The horns of cattle are at times pared and shaped to improve their appearance, the tips are sometimes capped with ornamental brass or bell metal ferules At large fairs pure white bulls have their front and hind quarters painted blue The horns are invariably painted blue and scarlet in the '*Sankranti*' or harvest festival, when cattle are washed and decorated in various ways and driven across a line of blazing fire

Manner of working cattle

AGE.

TEETH, HORNS AND AGE

The age of cattle, as usual elsewhere is ascertained from the condition of the front teeth and their periodical changes Another indication of age, though less precise, is the appearance and growth of the horns in the earlier years and the number of hollow rings formed on them as the animal grows older

Ascertained from front teeth

The calf has, at birth, its two front teeth In about a month all the eight teeth are up In the majority of cases where teething is regular, the first formed pair exhibits signs of wearing at one and a half to two years and, falling at about two and a half years, is replaced at three In a falling pair, one is said to fall off usually a few days or weeks before the other, The second pair of the original teeth, one on each side of the front pair, is similarly replaced from three and a half to four years, the third pair from four and a half to five, and the last pair, to complete eight teeth, is up in level with the others when the animal is six years old, having replaced the last temporary pair at five and a half This is the usual and what is considered to be the regular course of cutting teeth, the intervals slightly varying in different cases. Cattle teeth show no sign of wearing till after about ten years, when the wearing begins to be appreciable in the first formed set of teeth, gradually extending to the others All the eight teeth fully wear out at about thirteen or fourteen years, and at sixteen or so the animal becomes incapable of grazing in the pastures, as proper prehension of food by the worn-out teeth becomes difficult. The conclusion as to age from the state of teeth is further invariably verified by the size and appearance of the animal Between its birth and the fall of its first pair of teeth, the size of the animal and the length of the tuft of hair at the end of the tail are the chief guides, while from full mouth to the wearing of teeth its appearance and vigour, the gloss of its skin and hairs and its general activity are the only data for estimating the age When the animal is very old, its pendulous belly, long horns, rough and rather dry muzzle and sparsely growing hairs approximately indicate its age

As exceptions to the general rule, cases may be mentioned in which the first pair of permanent teeth appears well up as early as two years or at various points of time between two and three. Instances are also known where the interval between the appearance of the first set of teeth and of the second set is much longer than a year, and where the second and third sets instead of following the first in regular succession fall off together and are simultaneously replaced, the last set, however, taking the usual time In some cases the several sets of teeth get replaced at short intervals from three to six months, so that the animal becomes full mouthed at four and a half or five years There are again some cases in which the first set of permanent teeth begin to show symptoms of wearing before the last set is replaced Such are some of the irregularities in dentition Teeth formed in regular course of dentition are stronger and last longer than those cut

irregularly Teeth of cattle grazing in stony soils naturally wear out earlier Irregularity in teething must of course upset calculations of age founded upon regular dentition, the only data for estimating age in those cases being the other conditions already referred to.

One ring is formed on the horns when the animal has two permanent teeth, and every subsequent year so that the age of the animal may be roughly determined by inspecting the horns This is, however, a very unreliable method as the rings are often pared off

SELETCION OF CATTLE FOR DIFFERENT PURPOSES.

It may be useful to give here a brief account of the points which are generally understood by raiyats and breeders to indicate special fitness of cattle for the various services required of them Cattle are to be judged by their capacity or fitness (1) for heavy draught, (2) for fast trotting or walking with a moderate weight to pull, (3) for carrying heavy loads as pack bullocks (4) for enduring fatigue and heat and exposure to the weather, (5) for milking, (6) for butter producing, (7) for slaughter, (8) for breeding, and (9) for breaking in unruly and untrained animals

Points of animals adapted for heavy draught

The characteristics of animals adapted for slow but heavy draught are—

(*a*) Height, length and a big frame
(*b*) Thick, short and strong neck
(*c*) Broad chest and loins with a level back
(*d*) Well rounded barrel having strong, broad and deeply bent ribs
(*e*) Short legs, good bone and well formed but massive shoulders and hind quarters

Cattle of the *Mahadeswara betta* breed and those castrated after cutting six teeth are generally considered best fitted for heavy slow draught

Characteristics of animals intended for fast trotting

In animals intended for fast trotting the mechanical requirements are different and to some extent the very reverse of those fitted for heavy draught —

(*a*) A medium sized but very compactly knit frame
(*b*) A long and comparatively thin neck and well balanced head
(*c*) More or less level back and broad loins
(*d*) A round but compact barrel
(*e*) Long and thick le[illegible] l small fetlocks
(*f*) Small hump, de[illegible] th
(*g*) Thin and tight
(*h*) Narrow flanks

The cattle of the Ca[illegible] general[illegible]an[illegible] those castrated at an early a[illegible] h and[illegible] n to

SELECTION

be very speedy animals. Among other features of fast trotting bullocks may be mentioned short, thin tail, small ears, thin, long horns, thin, soft hair, red eyes, long face, and muscles like whipcord

Pack animals

The points of pack animals intended for carrying heavy loads are—

(*a*) Bony, compact frame.

(*b*) Strong chest and loins, equally and well developed. If these are weak, the animal struggles in ascents and descents

(*c*) A level and wide back with strong vertebræ and well arched ribs

(*d*) Short, straight and stout legs with short pasterns and well developed shoulders and thighs

If the animals are short, it is all the better for loading. Cattle designed for this purpose should not be allowed to breed prior to castration which should be effected at the beginning of the sixth year. Most cattle suitable for this kind of work are found among the "*Nadudana*". As these animals have to traverse all kinds of soils and uneven ground, they should be particularly strong in points (*b*), (*c*) and (*d*) and should have besides, strong, hard hoofs, of which the two halves should be equal

Animals for work involving fatigue

The points of animals intended for work involving much fatigue and exposure are the same as those of fast trotting bullocks. The smaller and more compact the animals the more capable are they of standing fatigue. A hardy course of treatment in breeding such as the *Amrut Mahal* and other semi wild herds undergo, prepares them for any extraordinary call upon their powers of endurance. White-skinned cattle are delicate. They get a staring coat in the cold weather, are easily tired and perspire under work, and cannot stand heat or the inclemencies of the weather. Black skinned animals on the contrary, are hardy and can resist the effects of exposure. Cattle of the *Hallikar* breed and many bulls of the "*Nadudana*," especially those of *Linnadahalli, Pavagada Midigesi, Bettadapur* and *Meleikuppe*, are known to be hardy, spirited, and capable of enduring much fatigue

Characteristics of a good milker.

The points of a good milking cow are not well understood by the generality of breeders, dairy farming being in a backward state. From observations made, the following peculiarities appear to characterise good milkers —

(*a*) The neck is long and thin and carries a comparatively small head

(*b*) The girth at the chest is much less than that at the loins, the greater this difference the greater the milking capacity, but the fall should be gradual

(*c*) The udder is large and has big teats

(*d*) The calibre of the milk veins is large with extensive ramifications forming knots in their course. If these are continued backwards over and beyond the udder into the milk-mirror, it is still better

OXEN.	The Cattle of

SELECTION.

(*e*) The skin is thin, loose and soft, having fine downy hairs, and sometimes greasy to the touch

Points of a good milker.

It is asserted by some that the thighs should be thin and stand far apart There is a difference of opinion on this point Good milkers often have ugly shaped and small horns, but this does not appear to be the rule Cows with a deep, pendulous belly and having small and shrunken udders are bad milkers. Size of the udder is not, however, an unfailing test of a good milker Indeed the peculiarities generally accepted as indicating good or bad milkers are not an infallible criterion, and the most critical eye often fails in correctly estimating the capacity of the cow Cows are known to yield more milk when they drop their second, third, and fourth calves, declining gradually from that time in their yield of milk with every successive calf, unlike buffaloes in which milk increases with every successive calf The yield is comparatively poor at the first calving. Cattle kept in "*roppas*" in a semi wild state are generally bad milkers. Mysore cows are on the whole bad milkers, the average yield being from half to one seer each morning and evening Of the several breeds found in the Province cows of the *Mahadeswara betta* breed are the best milkers though judged by the standard of the "*Gokai*" or *Nellore* cows the quantity is poor and the quality inferior except when special foods are given An average cow of this breed with good food, yields $1\frac{1}{2}$ seers each time or 3 seers a day, allowing as much for the calf. Cows of other breeds yield richer milk, though the quantity is less The *Amrut Mahal* and the kindred *Hallikar* breed of *Karadahalli* are bad milkers Of dairy produce, *ghi* is the only valuable article Milk is in little demand, except in towns In villages milk is not used as food, and is rarely sold. Butter-milk or curds, from which butter has been extracted, mixed with ragi ball or rice, is a dish of the people. Milk and curds have value in the neighbourhood of towns Numbers of people, women mostly, from the surrounding villages may be seen pouring into large towns of a morning to sell their milk, butter, curds, and *ghi*. Systematic dairy farming on any large scale is as yet unknown

Yield of butter.

Cows differ much in their yield of butter. Good butter-producing cows have generally compact udders and small teats The teats are glossy and hard and difficult to milk This may be due either to the orifice at the tip of the teats being small or to the milk being thick, being impregnated with fatty and solid matter. Milk containing much butyracious matter is heavier, sweeter and less frothy Generally cows whose udder and the milk mirror are greasy to the touch, produce more butter for a given quantity of milk *Hallikar* and village cattle are generally good butter producers

Animals are not, as a rule, bred purely for slaughter purposes, as the demand for them is confined to towns inhabited by Europeans and Mahamadans Cattle discarded from other services are generally the only ones sold to butchers.

Mysore. (*A Kristnamangar and H. T. Pease*) | OXEN.

AMRUT MAHAL CATTLE.

Large sized, heavy and strong animals, slow by nature, and docile in their habits, are employed for breaking in semi wild and untamed animals. Cattle of *Mahadeswara betta* breed are particularly fitted for this work.

AMRUT MAHAL BREED.

Among the breeds found in Mysore the first place is undoubtedly taken by the Amrut Mahal. The following history of the breeds is summarised from Colonel Hay's report and other records. The different breeds composing the present *Amrut Mahal* cattle owe their origin to the cattle of the tribe of *Gollas* and their sub-tribe of *Hallikars* who, with their superior cattle, are believed to have migrated in ancient times in several successive waves from the North and settled in different parts now comprised in the Chitaldroog and Tumkur Districts.

History of the Breed.

The "*Karukatti*" establishment of the Vijayanagar Viceroy (some time between 1572 and 1600) at Seringapatam consisted of *Hallikar* cows imported from Vijayanagar. This may be said to have been the nucleus of the *Amrut Mahal* cattle. The Seringapatam cattle passed into the hands of Wadayars of Mysore, some of whom, notably Chamaraj Wadayar (1617—1636), Kartirava Narasaraj Wadayar (1638—1658), and the celebrated Chikka Devaraj Wadayar (1672—1704) made their own additions to them from time to time, assigning "*kavals*" in different parts of the Kingdom. It was in Chikka Devaraj Wadayar's time that the cattle establishment obtained recognition as one of the departments of the Administration. It was called "*benne chavadi*" or establishment of cows both as a breeding stud and to furnish milk and butter for the Palace. He introduced for the first time the system of branding them with his initial. The accumulated herds of the Rajas of Mysore passed on to Hyder Ali when he usurped the throne. In extending his conquest and in reducing the numerous rulers who had held sway over more or less extensive tracts in Mysore, he acquired also the herds of superior cattle belonging to them. Among these may be mentioned the Pallegars of Chitaldroog, Tarikere and the Raja of Nagar. Hyder seems to have made extensive use of the cattle which he had appropriated in the movements of his army equipage, and is popularly credited with having kept at least 60,000 bullocks in different parts of the Province, though they were not organised as carefully and in as minute details as was afterwards done by Tippu, on a system which has in essential points been adhered to ever since. Upon succeeding to the throne of his father, Tippu added to these herds those of the Pallegar of Hagalvadi. Chikka Devaraj Wadayar's suggestive name of "*Benne chavadi*" was changed in his time into a more pompous one of *Amrut Mahal* from *Amruta*=Nectar. Tippu took great interest and issued a "*Hukumnama,*" or regulations for the Department, the greater part of which continued to be observed after the taking of Seringapatam, and the same system was afterwards followed by the British officers. The

AMRUT MAHAL CATTLE.

Dairy Department seems to have been on a large scale and amildars were expected to train the young steers which were allowed to graze in the raiyats' fields and were classified when required as gun bullocks, pack bullocks, and plough bullocks, etc There was an annual muster of the herds, and Tippu frequently attended it in person and distributed rewards Such was the composition of the *Amrut Mahal* cattle inaugurated by Chikka Devaraj Wadayar, reconstituted by Hyder Ali and thoroughly organised by Tippu Sultan

The attention of the British was first called to the excellence of the breed when it enabled Hyder Ali to march 100 miles in two days and a half to the relief of Chellumbrum, and after every defeat, to draw off his guns in the face of his enemies, and when Tippu Sultan was enabled to cross the Peninsula in one month for the recovery of Bednore and to march 63 miles in two days before General Meadows It also enabled the Duke of Wellington to execute those marches of unexampled rapidity which are the admiration of military men, and the Duke brought it prominently to the notice of the then Commander in Chief Lieutenant General Stuart. Other memorable military events might also be cited to the credit of these cattle It is said that during the Peninsular War the Duke often regretted that he had not the services of the cattle of this breed On the fall of Seringapatam the whole of the cattle became the property of the British Government, the management of the herds being allowed to remain with the Maharaja of Mysore, on the condition of his supplying a certain number of bullocks It was probably imagined that the same attention would be given to the establishment as had been extended to it by the former Government, but Tippu Sultan had depended on it for the efficiency of his army, and the new Government could be actuated by no such motive. The consequence was that the establishment was left to the servants who had charge of it, and by them neglected and abused; the British Government were disappointed in their expected supplies, and the cattle were allowed to degenerate to such a degree that after a period of thirteen years it became necessary to resume charge of it in order to preserve the breed from extinction In 1813 the *Amrut Mahal* cattle, together with the pasture lands were handed over to Captain Harvey of the Madras Commissariat The herds then rapidly improved and doubled in number in the course of but ten years In 1840 the Maharaja's herds and grazings were amalgamated with those of the British Government and the whole placed under the officers of the Mysore Commission In 1860 from motives of economy, Sir Charles Trevelyan ordered the establishment to be broken up and the herds to be sold, this appears to have been a fatal error alike in policy and economy, and the results were detrimental to the public service The price of cattle soon became prohibitive (R150 each), and it was with the cordial approval and assistance of the late Maharaja re established in 1866 by the purchase of such cows and bulls of the old

AMRUT MAHAL CATTLE.

breed as were procurable in the Mysore Country, very few were obtained owing to the Pasha of Egypt having secured most of the best blood, fortunately, however, the late Maharaja was a large purchaser when the old establishment was broken up, and the Madras Government was able to obtain sufficient stock to fairly start again in 1870, the complement being 4,000 cows and 100 bulls

In 1883 the British Government handed over this valuable property to the Government of His Highness the Maharaja for R2,25,000 It is now entirely under its control, and every effort is made by careful elimination of doubtful stock to restore the old breed Stud books have been opened, and the cattle are mustered annually by name and brand Births and deaths are registered and reported in monthly returns, and frauds on the part of subordinates have been to a great extent prevented The Madras Government receive from the establishment 200 bullocks annually

Originally included three varieties

The cattle of this breed originally comprised three distinct varieties (1) Hallikar, (2) Hagalvadi, and (3) Chitaldroog Prior to the abolition of the Department in 1860, the several herds seized by Hyder and Tippu seem to have been maintained for the most part unmixed as separate "*Serwés*," the distinguishing peculiarity of each breed being thus kept unadulterated In 1866, when the Department had to be organised afresh by re purchasing the stock, it was found impracticable to get back in their original purity all the cattle sold six years before At this juncture the men to whom the work of fetching the cows was entrusted on promise of appointing them "*Serwegars*," freely mixed the three main varieties of the old Amrut Mahal, besides introducing a large number of inferior cows of every other breed including their own bred cattle known as "*Swanta gosu*" A very great number of *Mahadeswara betta* cows are also said to have been passed off for the reconstitution of the Department During recent reductions and reconstitution of "*Serwés*" since 1877 many herds have been broken up and distributed among others, new herds have been formed out of the excess stock of the old ones, and exchanges of stock are often being made between different "*Serwés*," all tending to promote mixture The present *Amrut Mahal* cannot therefore be said to be as pure as it was prior to 1860, although careful selection and uniformity of treatment in recent years seem to have erased a good many points of difference which must have necessarily existed at the time of reconstitution of the herds in 1866. The different breeds, *Hallikar*, *Hogalvadi* and *Chitaldroog*, vary but slightly, their general character being the same The *Hallikar* is considered to be the best The distinguishing features may be gathered from the following description —

Chief points

"The head is well shaped, long and tapering towards the muzzle which is generally black; the forehead bulges out slightly and is narrow and furrowed in the middle The horns are unique in shape and differ considerably from most other breeds. They are usually large, set well back on the crest of the frontal bones springing close together, they diverge inclining backwards each in a straight line for

Allied Breed.

Gosu or Swanta Gosu Cattle—*Gosu* is a mixed breed of cattle, being a cross originally between select cows of "*Nadudana*" and pure *Amrut Mahal* bulls The herds form the property of the "*Serwégars*" of the *Amrut Mahal* Department who are allowed the privilege of keeping their cattle with Government herds Having been long associated with the *Amrut Mahal* breed, *Gosu* cattle are little different from, or inferior to, them

HALLIKAR BREED.

The history of this breed has already been given under the head of the *Amrut Mahal* cattle, of which the *Hallikar* breed is the most important and valuable member It need only be added here that while the name of *Gollas* has disappeared among cattle, that of *Hallikars*, their sub-tribe, has survived in the cattle which they introduced into Mysore

Where met with

Hallikar cattle are found, besides the Government *Amrut Mahal* herds in the Tumkur, Hassan, and Mysore Districts, the chief centres being parts of the Nagamangala, Kunigal and Gubbi Taluks. The area over which the breed prevails is not by any means extensive, and it is thinly scattered even within those limits. The reason is obvious There are no extensive pastures in the habitat of these cattle, and the tracts being populous they are mostly home fed and are not maintained in great numbers except by a few breeders in the Nagamangala, Gubbi, and Kunigal Taluks They are bred in small numbers by the agricultural classes in many villages.

The features of this breed have been fully described under the *Amrut Mahal* cattle and need not be repeated. They are strongly characteristic and make the contrast between this breed and the *Mahadaswara betta* cattle patent and striking Such slight differences as exist between it and the allied *Chitaldroog* breed will be stated further on.

Care practised in breeding

Special attention is given to the matter of selection in breeding Cows are never allowed to be served by inferior bulls, though no restriction is enforced as to the age of cows fit for breeding. Heifers at 2½ years are allowed to breed if they happen to be in season Special breeding bulls of this breed are maintained by private owners to be hired out for service The cows are rarely milked, and even when they are, very little milk is drawn and only in the mornings, the calves being allowed to go with the mothers Calves are weaned when they are three or four months old if there is a demand for them Cows are driven out to graze during the day and are housed and fed at night except in those few instances in which they are kept in "*roppas*" Late castration is the rule, though sometimes bulls are castrated early. The following measurements are given for reference :—

OXEN.

HALLIKAR CATTLE

Measurements.

Mysore. (*A Kristnamangar and H T Pease*)

Measurements, etc., of the Hallikar Breed of Cattle

Sex.	Age.	Height at shoulder	Height at croup	Height at elbow	Length from poll to buttock	Length of horn	Length of ear	Length of face	Breadth of forehead	Girth at chest	Girth at abdomen	Girth of forearm	Girth of shank	Length of neck	Length of shank	Color of skin	Color of hair.	Remarks
Bull .	4	55	55½	–	72	9½	9¾	21	5	76	79	13	7¾	19	9½	Black	Slate	
Bull .	10	53	54	...	77	17	9	20	5	70	73	13	7	17	9½	Do	Do	
Bull .	5	56	57	–	80	15½	11	22	8	51	74	13½	8	17	9¾	Do	Do	
Cow .	10	47	51	–	[illegible]	17	8½	15	8	60	67	0	6	16	9¾	Do	Green	

HALLIKAR CATTLE

ALLIED BREED

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Mysore (*A Kristnamangar and H T Pease*) | **OXEN.**

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Bull	10	53	54		77	17	9	20	8	70	72	13	7	17	9½	Do	Do	
Bull	5	56	57		80	15½	11	23	8	81	74	13½	8	17	9½	Do	Do	
Cow	10	47	51		67½	17	8½	18	8	60	67	o	6	16	9½	Do	Green	

OXEN	The Cattle of

HALLIKAR CATTLE

Cows are generally grey in color, they have small and compact udders with small and hard teats They are poor milkers, though the milk is rich and sweet with a high percentage of butyracious matter The cattle are of high mettle, and though mostly home bred, are not gentle or tractable There is always a great demand for these cattle, and as the number annually produced is not sufficient to meet it, high prices prevail The average market value is:—Very good (breeding) bulls R80 to R120 Average bulls R50 to R75 Very good cows R60 to R100 Average cows R40 to R60 Bull calves of one year R20 to R40

Prices.

Noteworthy example of the breed

One remarkable specimen of the breed deserves special mention This is found at Karadahalli in the Nagamangala Taluk *Gujmavu*, the most valuable variety of the *Hallikar* breed, commands very high prices Tradition ascribes its origin to a cow crossed by a buck. One peculiar point in these cattle is their great length, and which gives them a greater mechanical advantage and strength The state of nature under which the *Amrut Mahal** cattle grow is imitated in some degree by the Karadahalli breeders who send their herds to distant jungles in the Heggaddevankote Taluk for the benefit of the early season pasture Hence is seen among the *Karadahalli* breed the same uniform shape, color and horns Superior bulls are kept at Karadahalli for breeding purposes Cows even from distant places are taken to these bulls for service upon payment of a fee of R1 to R4 for each service The raiyats of the neighbouring Taluks of Mandya, Seringapatam and Closepet advance to the breeders of Karadahalli R50 to R100 for calves still in the mother's womb If a cow-calf is dropped the advance is returned, as it is not customary for the Karadahalli breeders to sell cows of their breed If a bull calf is brought forth it is sold according to the original agreement In some cases such sales are subject to the provision that the calf should be reared for two years and resold to the original owner for its full value at the time of its resale, which generally is R100 to R200 This system of selling and reselling obtains as it affords a convenient division of labor

Description of Karadahalli (Gujmavu) Breed

A breeding bull of *Karadahalli* of *Gujmavu* variety is not inferior in points of excellence to any *Amrut Mahal* bull The same well formed head, gracefully tapering towards the muzzle, the same prominent forehead, intelligent and quick eyes, small ears, and elegantly shaped horns characterise this bull His powerful shoulders, strong muscular legs, flinty hoofs broad chest, deep ribbed and rounded barrel, and by no means ill proportioned hind quarters, give an idea at once of strength, endurance and speed In color he is somewhat motley, with patches of pure grey on dark grey ground The bulls do not attain any large size, the average height being 49 inches. The bulls are castrated in their 5th year and are of good size, compact frame and powerful muscles The regular breeders of Karadahalli are aware of the importance of preventing immature, inferior and deformed bulls from breeding, and accordingly castrate them betimes The bulls are somewhat diffi

HALLIKAR CATTLE

cult to tame at first, but when once tamed they are far more tractable than *Amrut Mahal* cattle, which to the last retain more or less their impatience of strangers. Good *Gujmaru* cows of this locality are little different from *Amrut Mahal* cows. The shape of the head, face and muzzle, the eyes, ears, horns, neck, legs and barrel are exactly of the same type. The similarity extends even to the masculine look of the cow. Cows are seldom sold to strangers. They are very highly priced, and though their appearance is not generally such as to give an idea of the value, raiyats and breeders seem to know and appreciate their virtue which is said to consist in producing calves, precisely and without divergence, like the covering bull, whatever its breed or quality. Particular notice has been taken of this variety, not only because it is a creditable instance of successful private enterprise, a more efficient and appropriate agency than a Government establishment in carrying out an industrial undertaking like cattle-breeding, but likewise in the hope that it may be the means of inducing owners of good cows to send them to be covered by the bulls. At present the breed is confined to a limited locality and to a restricted number of breeders, and though this has its advantages in securing purity and uniformity in the hands of experts in good cattle breeding, still even other types of cattle might be considerably improved by crossing with the bulls.

Karadahalli (Gujmaru) Cows

Allied Cattle

Hagalvadi Breed.—This seems to have been, at one time, a valuable breed, large herds belonging to the Pallegar of Hagalvadi (now in the Gubbi Taluk of the Tumkur District) were appropriated by Tippu when he took Hagalvadi. The breed has no existence now as distinct from *Hallikar* and are hardly distinguishable from them.

Allied Breeds

Bettadapur Breed.—This is a mixed breed—a cross between country or "*Nadu*" cows and pure *Hallikar* bulls, tracing its origin to the times when the Mysore Wadiyars had their cattle in the "*Kavals*" of Bettadapur and its neighbourhood. The breed is thinly distributed in the Taluks of Krishnarajpet, Yedatoré, Hunsur, Hollé-Narsipur, Arkalgud and Hassan. Its chief breeding centre is now a group of Hallikar villages Ichur and others situated to the west and south west of Bettadapur, in the Hunsur Taluk. This breed is inferior to the *Hallikar* in color, symmetry of form and shape of horns which are irregular and thick. It has, however, the same spirit and powers of endurance and is in great demand all over the west of Mysore and in Coorg. Great numbers are sold at the annual "*Jatra*" of Chunchankatté. The breed has degenerated of late years owing to the scarcity of good bulls and to bad management, many small cattle being now mixed with it.

CHITALDROOG BREED

The *Chitaldroog* breed owes its origin to the cattle of the ancient

OXEN.	The Cattle of

CHITAL DROOG CATTLE

Gollas who settled in that District The Pallegars of Chitaldroog formed their own herds from the flower of the *Goll* cattle, and these upon Hyder's conquest were united with his cattle establishment In the auction sales of the *Amrut Mahal* cattle upon the dissolution of that Department in 1860, the largest purchases were made in the Chitaldroog District and one or two taluks of the neighbouring District of Shimoga During recent years, again, the surplus stock of this Department have been frequently sold These circumstances have had the effect of throwing into that region a great number of cows of the *Amrut Mahal* breed which are found to predominate not only in herds but also in villages Cattle of this breed are found all over the Chitaldroog District and in adjoining parts of the neighbouring District The chief breeding centres are the Taluks of Challakeré, Hiriyur, Chitaldroog, Holalkeré, and Channagiri

Points of difference from Hallikar Breed

The breed bears a close resemblance to the Hallikar, differing from it only in some minor points, *viz*, the head is smaller and shorter but not stumpy like that of the *Mahadeswara betta* cattle The forehead resembles that of the Hallikar, though owing to the shortness of the head it does not appear to be so narrow, and the furrow is absent The horns are thinner, longer and taper more gradually, but as they grow upwards they separate more from each other and bend forward with a deeper curve, The neck, tail and dewlap are thinner In color, the breed is inferior, white being predominant, in size they are smaller only slightly in the western but in a greater degree in the eastern, parts of its habitat, *i e* Chitaldroog and Challakeré

Breeding

These cattle are kept in "*roppas*" as well as in villages, and are bred and treated in the same manner as the *Mahadeswara betta* cattle Cows come to early maturity, taking the bull usually in the 4th year When fresh grass springs up with the early rains, all the large herds are driven to salt lands and are allowed to lick earth salt which operates as a purgative and tends to improve their condition when grazing in fresh pastures

In temper they are not different, but being smaller and as compact they are exceedingly active and quick footed

More numerous than Hallikar Cattle

Prices

As dairy animals they are not superior Bullocks of this breed are chiefly used for cart draught *The breed is much larger numerically than Hallikar*, and the supply is considerable Great numbers are annually purchased by the raiyats of the neighbouring Districts of the Bombay Presidency The average market value is as follows —First quality bull R70 to R100, superior cow R50 to R70, average bull, R40 to R70, average cow, R30 to R50 The following measurements are given for reference —

OXEN.

Mysore. (*A. Kristnamangar and H. T. Pease.*)

CHITALDROOG CATTLE.

Measurements.

Measurements, etc., of the Chittaldroog Breed of Cattle.

Sex.	Age.	Height at shoulder.	Height at croup.	Height at elbow.	Length.	Length of horn.	Length of ear.	Length of face.	Breadth of forehead.	Girth at chest.	Girth at abdomen.	Girth of forearm.	Girth of shank.	Length of neck.	Length of shank.	Color of skin.	Color of hair.	Remarks.
Bull .	5	53	56	...	74½	17	10	20	8	72	72	13	7½	20	9½	Black.	Slate.	
Bull .	6	52	53	.	80	15	10	21	8	77	80	15	8	19	9	Do.	Do.	.
Bull .	5	52	53	..	79	11	9½	20	7	69	72	13	6¾	16	7¾	Do.	Do.	
Cow	9	45	46	.	68	10	9¾	16	7	58	62	9½	5¾	17	8½	Do.	Grey.	

OXEN.	The Cattle of

CHITALDROOG CATTLE

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Mysore. (*A. Kristnamaswamy* [illegible])

Measurements, etc., of the Chittaldroog Breed of Cattle.

Remarks				
Color of hair.	Slate.	Do.	Do.	[illegible]
Color of skin.	Black.	Do.	Do.	Do.
Length of shank.	[illegible]	[illegible]	[illegible]	[illegible]
Length of neck.	20	[illegible]	[illegible]	[illegible]
Girth of shank.	[illegible]	[illegible]	[illegible]	[illegible]
Girth of forearm.	[illegible]	[illegible]	[illegible]	[illegible]
Girth at abdomen	[illegible]	[illegible]	[illegible]	
Girth at chest	[illegible]		[illegible]	
Breadth of forehead	[illegible]	[illegible]		
Length of face	[illegible]	[illegible]		
Length of ear	[illegible]	[illegible]		
Length of horn				
[illegible]	[illegible]			
[illegible]				
[illegible]				

OXEN.	The Cattle of

CHITALDROOG CATTLE

Allied Breeds

Account by Buchanan

Allied Cattle.

With regard to the Chitaldroog and allied breeds, the following remarks by Buchanan at the commencement of the century may not be out of place, as they show pretty clearly the material there was to work upon in the Chitaldroog tract

Midighesi —The country around Midighesi is full of little hills, and overgrown with copse-wood The villages of the "*Gollas*" or cow-keepers are scattered about in the woods and surrounded by a little cultivation of dry field Want of water is everywhere severely felt.

Every town and village in this hilly country has herds of breeding cattle The cattle are fierce, without the protection of the keepers it would be unsafe to approach them

In this country the *Kadu Gollas* or *Gollaru* are those who breed cattle Their families live in small villages near the skirts of the woods, where they cultivate a little ground and keep some of their cattle, selling in the towns the produce of the dairy Their families are very numerous, seven or eight young men in each being common Two or three of these attend the herds in the woods, whilst the remainder cultivate their fields and supply firewood and straw for thatch to towns Some of them also hire themselves to farmers as servants. They wear nothing but a blanket and generally sleep amongst the cattle

The race of oxen in this country may be readily distinguished from those of Bengal by the position of the horns, which in Bengal project forwards and form a considerable angle with the forehead, whereas in those of the south the horns are placed nearly in the same line with those of the Os fronti In this breed also the prepuce is always remarkably large and vestiges of the organ are also found in the female Of this southern breed there are several breeds of very different qualities Above the Ghats, however, two breeds are most prevalent The one is a small, gentle, brown or black animal, the cows are kept in the villages for giving milk, and the oxen are those chiefly employed in the plough; their short, thick make enabling them to labor easily in the small rice plots which are often but a few yards in length. This breed seems to owe its degeneracy to a want of proper bulls As each person in the village keeps only two or three cows for supplying his own family with milk, it is not an object with any one to keep a proper bull, and as the males are not emasculated until three years old, and are not kept separate from the cows, these are impregnated without any attention to improvement or even to prevent degeneracy. Wealthy farmers, however, who are anxious to improve their stock send some cows to be kept in the folds of the large kind, and to breed from good bulls The cows sprung from these always remain in the fold and in the third generation lose all marks of their parents' degeneracy The males are brought home for labor and in every village may be perceived all kinds of intermediate mongrels between the two breeds

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Mysore. (*A. Kristnamangar and H. T. Pease.*) | OXEN.

CHITALDROOG CATTLE.

Allied Breeds.

In the morning the village cows are milked, and are then collected together with all the buffaloes and oxen that are not employed in labor About 8 or 9 in the morning the herdsmen drive them to pasture. If the herd exceeds one hundred and thirty, two herdsmen must be kept, and their herds go in different directions The pastures are such waste lands as are not more than two miles distant from the village, and are in general poor; the tufts of grass are but thinly scattered, and bare soil occupies the greater space. The grass, however, seems to be of a very nourishing quality, and the most common species is the Andropogon Martini of *Roxburgh* * At noon and at 4 o'clock the cattle are driven to water. At sunset they return to the village, and in the rainy season the cow-house is smoked to keep away the flies In the backyard of every house stands a large earthen pot in which the water used for boiling the grain of the family is collected; and to this are added the remains of curdled milk, a little flour, oil cake, or cotton seed This water becomes very sour, and is given as a drink to the cows in the evening, when they are again milked At night, in the rainy season, the cattle get cut grass, which is collected in the woods and about the roadsides, the latter being the most nutritious, the very succulent roots being cut up with the leaves and the situation preventing the harsh stems from growing In dry weather the cattle at night have straw Those who can afford it give their milch cows cotton seed and "*aesray*" After the milk for the family has been taken, the calves are allowed to suck, and unless the calves are present during the milking, the cows withhold their milk The cows breed at three years of age once a year, and milk for six months only A good cow of the village breed gives about three seers of milk a day The cattle of the other breed are very fierce with strangers, and nobody can approach the herd with safety unless surrounded by "*Gollas,*" with whom they are very tractable, and the whole herd follow like dogs the man who conducts it to pasture The cattle of this breed never enter a house, but at night are shut up in folds which are strongly fortified with thorns to defend the cattle from tigers. At five years old the oxen are sold and continue to labor for twelve years Being very long in the body and capable of travelling far on little nourishment, the merchants purchase all the best for carriage To break one of them it requires three months' labor, and many of them continue always very unruly The bulls and cows are so restless that, even with the assistance of *Gollas*, I could not get them measured, but the dimensions of a medium sized ox were as follows — From nose to root of horn, 21 inches, from root of horn to top of hump, 30 inches, from top of hump to projecting part of ischium, 45 inches, hump to ground, 46 inches, croup to ground, 51 inches.

The cows of this breed are pure white, but the bulls have generally an admixture of black on the neck and quarters.

These cattle are entirely managed by *Gollas*, and some of these people

* Andropogon Schœnanthus.

OXEN	The Cattle of

CHITAL-DROOG CATTLE

Allied Breeds

have considerable property of this kind, but the greater part of these breeding flocks belong to the rich inhabitants of towns or villages, who hire the *Gollas* to take care of them, and for the advantage of better bulls send to the fold all their spare cows of the village breed In procuring bulls of a good kind some expense is incurred, for the price given for them is from £3-7 1 to £6 14-2, care is taken to emasculate all young males not intended for breeding, before they can injure the flock

The *Gollas* live in huts near the small villages, in parts of the country which contain no uncultivated land, and are surrounded by the folds, in which they always keep as many cattle as will cultivate a little land, and as the pasture near the place will maintain But as local failures of rain often occasion a want of forage near the huts, some of the men drive their flocks to other places where the season has been more favourable, and either take up their abode near the huts of some other *Gollas*, giving them the dung of their fold for the trouble they occasion, or live in the midst of the woods in places where small reservoirs, called *kattes*, have been formed to supply their cattle with water All the breeding and young cattle are carried on these expeditions, but a few laboring cattle and the buffaloes are left at home in charge of the women During the whole time they are absent they never sleep in a hut, but wrapped up in their blankets and accompanied by their dogs, they lie down among the cattle within the folds, where they burn fires to keep away the tigers. This sometimes is not sufficient, and these ferocious animals break through the fence and kill or wound the cattle The men have no firearms, the report of which would terrify the cattle No thieves can annoy their black cattle, for they are too unruly to be driven by any person but their keepers

Their cattle have nothing to eat except what they can pick up in the wastes Each day at sunrise they are driven out, as then the calves get all the milk, except a little used by the herdsmen, but near the villages they are milked, and each cow yields about two seers daily They are indeed miserably lean, and at 20 years their ribs may be distinctly counted The cattle are driven to water once a day, and the calves, when a month old, are driven to pasture with their mothers The profit on a hundred cows is estimated at £43-13 0, or 45 per cent on the original outlay

A *Golla* that is reckoned rich will have two hundred cows, thirty cow-buffaloes, fifty ewes, and a hundred she-goats, and will keep as many laboring oxen as will work three ploughs

The cattle in this country, as I have already mentioned, are milked by the men who carry the produce home to the women who prepare butter The milk, on its arrival, is immediately boiled for at least an hour, but two or three hours are reckoned better The earthen pots in which this is done are in general so nasty, that after this preparation no part of the produce of the dairy is tolerable to an European The natives never use

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CHITALDROOG CATTLE

raw milk, alleging that it has no flavour The boiled milk that the family has not used is allowed to cool in the same vessel, and a little of the "tyre" or former day's milk, curdled, is added to promote its coagulation and acid fermentation Next morning it has become tyre or coagulated acid milk. From the top of each potful 4 or 5 inches of tyre are taken and put into an earthen jar, where it is churned by turning round in it a split bamboo This is done very expertly by a rope which, like that of a turner's lathe, is passed two or three times round the bamboo, and a quick motion in contrary direction is given by pulling first one end of the rope and then the other After half an hour's churning some hot water is added and the operation is repeated for about half an hour more, when the butter forms The native never uses butter, but prefers what is called "*ghi*," not only as it keeps better, but also as it has more taste and smell In order to collect a sufficient quantity for making *ghi* the butter is often kept for two or three days, and in that time a warm climate renders it highly rancid. When a sufficient quantity has been collected, it is melted in an earthen pot and boiled, until all the water mixed with the butter has been evaporated It is then taken from the fire and a little tyre and salt or betel leaf are added It is kept in pots, has a very strong smell and is best preserved from spoiling by a little tamarind and salt which, at any rate, enter into the dishes of all natives who can afford to use *ghi* Buffaloes' milk yields more *ghi* than cows' milk, and cows' more than goats' milk

Allied Breeds.

Pavagada and Midighesi Cattle—These sub-breeds of the *Chitaldroog* cattle are of a smaller type They are found all over the Pavagada and parts of the Maddagiri Taluks The tracts are hilly and stony with extensive grazing The breed is a cross between '*Nadudana*' and *Golla* cattle, brought into existence when the tribe settled in this region They partake of the appearance and character of both the parent breeds They are kept in "*reppas*" in herds, the annual production being large They are fine limbed and very compact, with very hard and small hoofs which do not often require shoeing Being active hardy and fleet footed, they are much used in light travelling Great numbers of these bullocks are purchased by trading Korchars, Lambanis and Waddars, who take and sell them for agricultural purposes to raiyats in the Shimoga District, where they are known as Koracha '*dana*" Calves are not weaned till the cows run dry The average market value of adult animals of this breed is as follows:—superior bull, R35 to R50, average bull, R30 to R35, superior cow, R25 to R35, average cow, R20 to R25

MAHADESWARA BETTA BREED

The breed derives its name from its chief market Mahadeswara betta in the Kollegal Taluk of the Coimbatore District, where two large cattle fairs are held in February and October, at which the cattle exhibited are

OXEN.	The Cattle of

MAHADESWARA BETTA CATTLE.

mostly of this description It is also called the *Betsal* or Cauvery breed, from its hilly home on either side of the Cauvery

Where met with

The chief habitat of this race of cattle is the Kankanhalli Taluk of the Bangalore District and those taluks in the Coimbatore and Salem Districts which are divided from Mysore by the River Cauvery The reason why these regions teem with great herds of cattle is that a wide expanse of forest land exists, not yet taken up for cultivation, with only patches of tillage in favored spots, which affords abundant pasture to the herds of cattle. The tracts are stony on the elevations and full of humus in the valleys The forest growth being all deciduous the pasture lands are thoroughly baked in summer by the heat of the sun so peculiarly intense in the valleys of low hilly regions Another reason, though one of secondary importance, is the presence of the Cauvery which affords cattle a perennial supply of water in seasons when the country generally is parched up Beyond these jungle centres but bordering on them, large herds of cattle are kept in villages commanding extensive pasture Cows and bulls of this breed, in small numbers, purchased from the large herds, are taken away and reared in "*Maidan*" villages of the Kolar Bangalore and Mysore Districts It is from these breeding tracts that all the cattle of this kind are exported to other districts at various ages

The whole habitat of the breed is favorable to the development of bone. The cattle are more massive of bone and of larger build than those found in the neighbourhood though often wanting in their symmetry of form, Taking a well developed adult bull of this breed as the type we find the following characteristic points —

Chief Features of the Breed

Head—Short and stout with a thick muzzle and broad forehead

Horns—Not so uniform as those of the *Amrut Mahal* and allied breeds, but are more so than those of the village cattle They are both stouter and shorter than the horns of the *Amrut Mahal* cattle, and have in some cases a rather sharp curve forward towards the upper half of their length They are usually black, sometimes being also of a light reddish brown

Eyes—More or less prominent, black and gentle to dullness, with the surrounding skin sometimes overhanging them

Neck—Short and thick

Dewlap—Thick, broad, hanging in folds sometimes continued backwards to the sheath

Ears—Long and erect, though in some rare cases rather pendulous.

Hump—Big and well developed

Legs—Short and stout with thick bones

Feet—Big, the periphery being large, with equal or unequal halves, cleft rather wide The hoofs are not so strong or hard as those of some other breeds, they never do for roads without shoeing, and are liable to get tender with hard work.

The Back—Is never straight, but inclines from the croup to the "*Sull*" (known as "Cowlick") and from there gently rising to the hump

MAHADESWARA BETTA CATTLE

Ribs —Well rounded and strong

Sheath —Deeply pendulous

The Pelvic portion—Droops from the croup to the tail It is usually narrower than is consistent with symmetry

Chief features of the breed

Tail —Long, thick at the root, and tapering rather abruptly The tuft of hair at the tip is usually thick and long.

Skin —Thick and loose, generally of a brown or almost black color, a jet black skin is rare

Color —The color of the hair in all pure specimens of the cows is either light, greyish, white or dark grey Broken colors are not uncommon owing to the extensive mixture found in the herds In size this breed is larger than the Amrut Mahal and kindred breeds Bulls are generally dark grey with a black mantle, their sleepy eyes, when a photograph was taken in the midst of a crowd of spectators, prove their complete domestication Under similar circumstances the *Amrut Mahal* bulls threatened to charge the photographer, camera and all.

Cows, though smaller, both in length and height, than the bulls answer to the same description The udder is fairly well developed, and in some cows the milk veins are prominent

The following measurements are given for reference —

OXEN.	The Cattle of

NADUDANA CATTLE

Allied Breeds

stout and the hoofs hard, but much bigger than what symmetry warrants The cows are noted for their rich milk They are well adapted for heavy draught, and in former times are said to have been of great service to the Pallegars of Tarikere as beasts of burden from hill fort to hill fort Efforts are now successfully being made to improve this breed by an admixture of the *Amrut Mahal*

Pavagada and Midghesi Cattle—Pavagada and Midghesi cattle, which are only village breeds improved, have already been noticed

Mellikuppe Cattle—These are village cattle crossed by *Amrut Mahal* bulls of herds quartered in the vicinity for the sake of the hot season pasturage of the south west jungles of the Heggadadevankoté and Hunsur Taluks They differ very little from ordinary village cattle in appearance, but possess in a certain degree the spirit and power of endurance of the *Amrut Mahal* cattle and like them are of fiery temper

Besides the above well known varieties of village cattle, many other less important known and recognized sub breeds exist in different parts Of all of them this may generally be observed that while their ordinary characteristics are the same diminutive size, diversity of form, variety of horns, and broken colors, any superior points found in them may be traced to the influence of local conditions and strains of those higher breeds with which they may have been brought into contact

Mysore. (*A. Kristnamangar and H. T. Pease.*)

OXEN.

CATTLE FAIRS HELD IN MYSORE.

Cattle Fairs held in Mysore.

District and Taluk.	Name of Place or Village.	Month.	Approximate number of Cattle.	Different breeds brought for sale.	Remarks.
Kolar District.					
Kolar	Vakkaleri	February	16,000	Nearly all of Mahadeswarabetta breed; Nandi and Mastidana; and 'Nadu dana.'	Besides these, there are 6 minor (annual) fairs and 25 weekly markets held in different parts of the Province in which the number offered for sale is less than 3,000.
	Vanarasi	April	15,000		
Sidlaghatta	Mallur	April	10,000		
	Talakavalabetta	February	4,000		
Bowringpet	Bowringpet	May	5,000		
Malur	Tornahalli	February	5 000		
	Chiktirupati	April	7,000		
	Chalaganahalli	April	4,000		
	Bhupatemmana betta	April	10 000		
Mulbagal	Avani	March	15,000		
	Yaldur	May	10,000		
Chikballapur	Nandi	March	18,000		
Tumkur District					
Korategere	Srikyamarahalli	January	3,000	Mahadeswarabetta and Hallikar breeds and a few of Pavgada breed.	
Pavgada	Nagalmadikè	January	3,000	Pavagada breed, a few of Mahadeswarabetta breed and 'Nadu-dana.'	
Shimoga District.					
Honnali	Rampur	February	6,000	Mahadeswarabetta, Chitaldroog, Amrut Mahal and 'Nadu.'	
Mysore District.					
Yadatore	Chunchanakattè	January	7,000	Hallikar, Bettadapur, Metikuppe and Mahadeswarabetta breeds and 'Nadudana.'	
Bangalore District.					
Nelamangala	Sivagangè	March or April	5,000	Mahadeswarabetta, Nandi and Masti and 'Nadu.'	
	Gollahalli	April	6,000		
Hoskote	Jadigenahalli	March	3,000		
Dodballapur	Subrayankanvè	January	30,000		
Anekal	Huskur	April	5,000		
Magadi	Magadi	April	3,000	Mahadeswarabetta, a few Hallikars and 'Nadu.'	

OXEN. — The Cattle of Mysore

AMRUT MAHAL and OTHER CATTLE. Measurements.

Measurements, etc., of the Mysore Breeds of Cattle.

Sex.	Age.	Height at shoulder.	Height at croup.	Height at [illegible] bow.	Length.	Length of head.	Length of ear.	Length of [illegible]	Breadth of forehead.	Girth at chest.	Girth at abdomen.	Girth of forearm.	Girth of shank.	Length of neck.	Length of shank.	Color of skin.	Color of hair.	Remarks.
							Amrut Mahal.											
Bull . .	6	[illegible]	[illegible]		75	18	9	20	9	63	69	13	7	16	9	Black.	Slate.	
Cow . .	8	49½	4[illegible]	.	67	21	8	17	9	59	61	9½	5½	17	8	Do.	Grey.	
							Nadudana.											
Bull . .	4	47	51	..	69	17	10	19	8	62	66	11	6	17	8	Various.		
Bull . .	7	41	43	.	66	21	8	17	7	60	63	10	6	16	7			
Bull . .	10	41	45	..	66	17	9	17	7	54	54	9	6	16	7			
Cow . .	4	41	45	.	61	9	8	16	6	55	60	8	5	13	8			
							Hasts and Nandi.											
Bull . .	5½	[illegible]	57½		71	16	10	21	8	77	79	14	7	18	8	Brown	Green	
							Betta Jafur.											
Bull . .	4	50	[illegible]	.	72	14	9	19	9	66	69	12	7	18	8	Brown	Green	
							Pataga la.											
Bull . .	5	43	45	..	60	11	9	16	7	53	57	9	5	16	7	Brown	Green.	
							Hegadahalli											
Bull . .	9	[illegible]	51		71	17	9	17	7½	65	67	11	7	16	7	Brown	Green.	

All communications regarding THE AGRICULTURAL LEDGER should be addressed to the Editor, Dr. George Watt, Reporter on Economic Products to the Government of India, Calcutta.

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In order to preserve a necessary relation to the various Departments of Government, contributions will be classified and numbered under certain series. Thus, for example, papers on Veterinary subjects will be registered under the Veterinary Series. Those on Forestry in the Forest Series. Papers of more direct Agricultural or Industrial interest will be grouped according as the products dealt with belong to the Vegetable or Animal Kingdom. In a like manner, contributions on Mineral and Metallic subjects will be registered under the Mineral Series.

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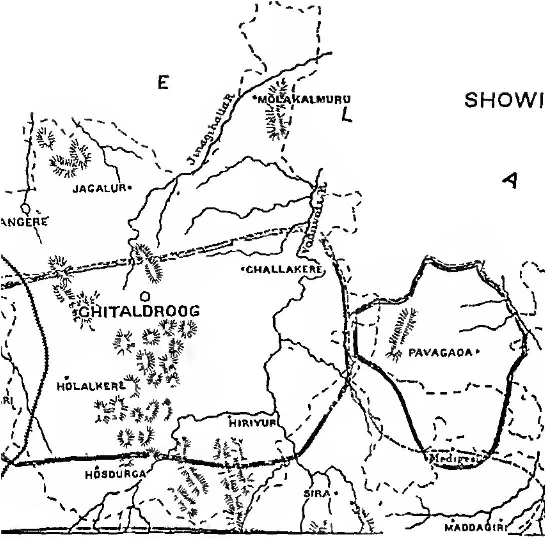

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HOSDURGA
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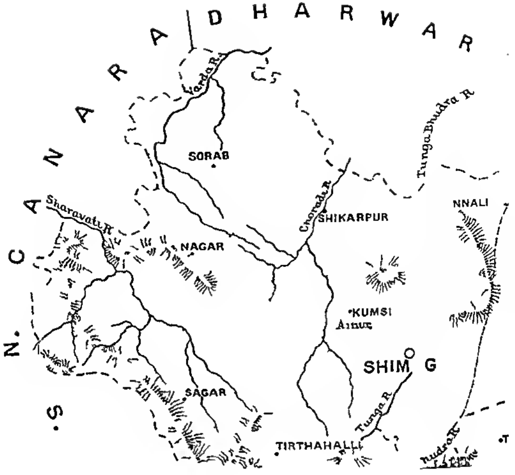
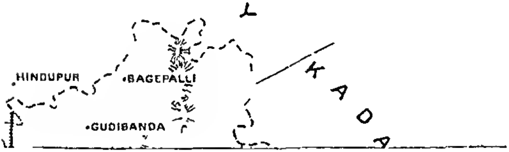

DHARWAR
N. CANARA
S.
Varda R.
SORAB
Tunga Bhudra R.
Chorada R.
SHIKARPUR
NNALI
Sharavati R.
NAGAR
KUMSI
SHIM G
SAGAR
Tunga R.
TIRTHAHALLI

Map of the

[YSORE PROVINCE

G THE APPROXIMATE DISTRIBUTION
OF BREEDS OF CATTLE.



THE

AGRICULTURAL LEDGER.

1895—No. 25.

OXEN.

[*DICTIONARY OF ECONOMIC PRODUCTS, Vol. V. O. 551–594.*]

BANKIPORE CROSS-BRED CATTLE.

Note by MR. N. N. BANERJEI, *Assistant Director of Land Records and Agriculture, Bengal,*

With extracts from reports received from—

Veterinary-Captain W. D. GUNN, Superintendent, Civil Veterinary Department, Bengal,

Mr. E. C. MACNAGHTEN, Secretary, Bihar Indigo Planters' Association.

Dr. J. W. LEATHER, Agricultural Chemist to the Government of India.

[*Reprinted from the Bulletin of Agriculture, published by the Department of Land Records and Agriculture, Bengal.*

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1896.

Price 1 anna.

CATTLE

establishment, and indeed the entire Institution, was placed by *Mr Tayler under English* supervision, but it would appear, that owing to differences of opinion as to the expediency of the procedure adopted by Mr Tayler in establishing and maintaining the Institution, it was soon closed The Institution, including the breeding establishment, broke up on Mr Tayler's transfer, after an existence of only a year or *two* *Subsequently, however, Mr Tayler estab*lished practice as a pleader in Patna, and then recommenced his Farm work His attention towards improving the breed of cattle in Patna, seems to have been given therefore both in his official and private capacity From what I could gather from the *ahirs*, the scheme at first did not receive their appreciation, for the simple fact that Mr. Tayler demanded too high a fee for each covering. The cross breeding at the beginning was therefore confined to Mr Tayler's Farm, and to some Europeans and wealthy native residents who could afford to pay his fees The fees were, however, *reduced with the second generation of* cross bred animals, and the local *ahirs* were then able to bring their cows to be covered by this second generation of cross bred bulls Two such bulls, I was told, were purchased by the *ahirs* themselves from Mr Tayler at Rs 80 each and used for breeding purposes Nobody could specify the breed of the original English bull, but from the description given me, I would say, it was probably a Durham bull The first generation of cross breds is said to have inherited all the good points of the sire, but the progeny was *found* to degenerate gradual [illegible] it is said, to proper want [illegible] this view of the matter [illegible] given to animals immediately before, during and after gestation, and it is also very probable, that from a desire to sell off milk to the best advantage, the calves were not allowed their full dole of *milk*, but then in the matter of housing and feeding, the greatest attention seemed to be given by the *ahirs* to their animals I am inclined to attribute traces of inferior strain to the absence of *fresh blood*, and certainly in some cases to the tendency that cows have to "throw back," *i e*, to give birth to inferior calves, when, in spite of their being put to a good bull, they have previously been *covered* by an inferior bull This last view is borne out by the fact, that the *ahirs* put their cows to the ordinary country bulls when cross-breds are not available for the purpose, the result being that when [illegible] l cross-bred bulls, their progeny is [illegible] when there has been no contact [illegible] ere has been a deterioration in the [illegible] that, in spite of the fact that the present stock of cross breds to be seen in Patna are distantly removed from fresh imported blood (being, according to the *ahirs*, of about the 20th generation), they still retain apparent *traces of their superior origin*, showing unmistakeable signs of foreign blood in

> The *ahirs* say that *Rs 20 was demanded for* each covering but I can hardly credit this
> N N B

CATTLE:

their make, shape, colour, size, &c. I would observe here, that my remarks apply to cows only. The cows I saw at Bankipore are the [illegible] perhaps well com- [illegible] are good milkers— [illegible] o even the poorest [illegible] milk a day The quality of the milk is also excellent The good effects of cross- [illegible] The same, however, [illegible] xture of English blood [illegible] licate for the Indian climate With cows, this makes no difference, as care is taken to bring them into their stalls when hot, and to keep them in open air during the cool part of the day and at night Draught bullocks, on the other hand, are found to succumb to the heat, and are not able to stand much outdoor work. The experiment in Patna thus clearly [illegible] bulls, though very good for [illegible] nals, is of no use for improv- [illegible] to observe that such cross-bred bullocks are not appreciated by cultivators as draught animals on account of the absence of the hump, which, they say, is necessary for the yoke

[illegible] yler's work has [illegible] done nothing [illegible] it shows, that [illegible] y, as the chief object here is to get strong and hardy cattle for the plough, which will be able to stand the Indian sun, and not simply to have good milch cows, for which latter, the demand at best is but limited and confined practically to large towns and to wealthier people than ordinary cultivators

In my opinion, if the agricultural stock of these Provinces are to be improved, bulls must be imported which can stand the Indian climate, and which would confer strength and powers of endurance to the progeny The bulls must be sought for, in short, in India

---

Extract from letter No 397 $\frac{V.D.}{95}$, dated 1st July 1895, from CAPTAIN W. D GUNN, *Superintendent, Civil Veterinary Department, Bengal*

I HAVE the honour to state that I also have been making enquiries with regard to that breed As Mr Banerjei has noted, the original idea of improving the breed of cattle was started in connection with the Bihar Industrial Institution. It was proposed to attach to it a farm where students might be instructed in agriculture. Before, however, the Institution was a year old—in fact, before the necessary buildings were completed, the money subscribed was returned to the subscribers, and the Institution closed It would

CATTLE

seem that in order to stock the farm the following animals were purchased —

	Rs
1 magnificent bull, imported by Major Holmes	600
2 English bulls from Mr Boilard	380
1 English bull from Dr Dickens	300
2 cows with calves from Dr Dickens	300

It does not seem clear, that all these animals were taken possession of, for when the affairs of the Bihar Industrial Institution were being wound up, a letter, dated November 1857, states that "two bulls were not forthcoming," and in another letter it was stated that "two bulls were returned to the Bettia Raj by Mr Tayler," the originator of the scheme The Nawab Wilayet Ali purchased one of the bulls when the Institution collapsed We, therefore, have left one bull, the *magnificent* one mentioned already, which Mr Tayler took charge of when the farm premises were removed to the Kunkerbag House

The fees proposed to be levied for the services of the bulls were 8 annas and 4 annas when the bulls belonged to the Institution farm, but possibly this charge might have been increased afterwards when the large bull became the property of Mr Tayler, but certainly not to the extent of Rs 20 for each service

The present animals will probably be the tenth generation, allowing four years between the birth of calf and dam, and even the present animals show an undoubted likeness to the original animals. Indeed, I have two photographs of bulls which bear such a strong likeness to their progenitor, that they might readily be mistaken for Kerry bulls

There is always a very large demand for milk, butter and *ghi*, and under these circumstances, I do not think Government could do better than to encourage this breed by lending or obtaining for the Patna Board or for Bankipore a good bull of the Dexter Kerry breed

I am aware, that the raiyats do not care for plough cattle which are deficient of hump, but it is not intended to utilize European bulls for other than milch cattle For plough and cart work, a judicious selection of indigenous Indian cattle will meet every requirement

I am at present engaged in endeavouring to obtain the transfer of Brahmini bulls from Bihar (where there are more than enough) and have them placed in charge of responsible persons in Lower Bengal For this purpose, I have interviewed Mr Forbes, Commissioner of Patna, Mr Hare, Collector of Muzaffarpur, and His Highness the Maharaja of Darbhanga, who have all considered the idea good and promised help On account of the milking qualities the *ahirs* of Patna pay great attention to their cattle so that this would be a most favourable place to start, or rather

CATTLE

continue, the experimental breeding, and I would therefore strongly recommend that two or three bulls of the Dexter Kerry breed be imported, and that at least one be stationed at Patna or Bankipore

---

Extract from a letter, dated 4th July 1895, from MR. E C MACNAGHTEN, *Secretary to the Bihar Indigo Planters' Association*

I THINK that, to a certain extent, Mr Banerjei has overlooked the importance of the "*ghi*" trade, which is certainly not confined to large towns Anything that tends to increase the milking qualities of cows must be good for the country, and I have never found any difficulty in using cross-bred bullocks in the plough or cart Buffaloes have no hump I have also found that cross-bred bullocks work well in the sun, they walk faster than country cattle, and do heavier work, though naturally, having to do this and being heavier framed, they may feel the sun more than light country cattle doing less work The curse of the country is the number of weedy bulls that are left loose annually, and no selection is made by cattle owners as to what bull shall serve their cows It is literally a case of "first come first served"

Cattle, in these districts, are degenerating yearly, new blood is badly wanted, and I myself would prefer English or half bred bulls If a few bulls were sent to Muzaffarpur, I would be pleased to look after them and to encourage cultivators to use them for their cows

---

Extract from a letter No 477, dated 29th January 1895, from DR J W LEATHER, *Agricultural Chemist to the Government of India*

Improvement in cattle—That the cattle around Tikari are diminutive there can be no doubt, and it is not difficult to point to breeds of cattle in other parts of India which are far superior to them.

When, however, one raises the question as to which breed would be the best to introduce, we find objections certainly to some For example, the large Hissar cattle are as fine as any in India There are also the Mysore and the Nellore cattle, both of which are excellent. But they are all large cattle, and will require more food than the little beasts at present in use. Would they, or any of them, do more work than the indigenous ones, so as to pay for their feed? Again, will they stand the climate, and, more particularly, the ploughing of rice fields when under water? A definite answer to these questions can only be obtained by trial

The most usual method of improving the breed of cattle in India, which has been tried, has been to keep a stud bull for serving any cows that the cultivators may choose to bring, there being generally

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